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JULY, 1947.

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Editorial Notices.

ALL articles submitted for publication in this journal must be typewritten and double or treble spacing should be used. Each article should conclude with a brief summary and statement of conclusions. Authors are requested to avoid the use of abbreviations and not to underline either words or phrases.

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Corrigendum.

With reference to the paper by K. W. Starr entitled "The Mechanical Fixation of Fractures of the Shafts of the Long Bones", published on page 248 of the April, 1947, issue of the Journal, the Editorial Committee regrets that the remarks attributed to Mr. D. J. Glissan, of Sydney, were inadvertently published as part of the discussion. They are an abbreviation of a paper delivered by Mr. Glissan at another session of the nineteenth annual general meeting of the College.

The announcements appearing in this journal contribute largely towards the maintenance of the high standard of the publication. It is, therefore, requested that, wherever possible, readers will support the business houses whose advertisements appear in the journal and that, when placing their orders, they will mention THE AUSTRALIAN AND NEW ZEALAND JOURNAL OF SURGERY.

THE AUSTRALIAN AND NEW ZEALAND JOURNAL OF SURGERY

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THE HAMILTON RUSSELL MEMORIAL LECTURE: THE PLACE OF SURGERY IN THE TREATMENT OF PEPTIC ULCER.[1]

By SIR HENEAGE OGILVIE,
London.

MR. PRESIDENT, members of the Council, and Fellows of the Royal Australasian College of Surgeons,

I have come to do homage to the memory of one of the founders of your College. Since I was honoured by your invitation to deliver the Hamilton Russell Memorial Lecture I have reread many of the works of this great man, whom I never met, but whose influence moulded the thought of the generation to which I belong. In the Anne MacKenzie Oration, delivered shortly before he died, he reviewed his own life and, speaking of his early apprenticeship to Lister, he quoted William Watson's verse:

> 'Tis human fortune's happiest height to be
> A spirit melodious, lucid, poised and whole;
> Second in order of felicity
> I hold it to have walked with such a soul.

I believe that many of his pupils and associates thought this way about Hamilton Russell—as a spirit melodious, lucid, poised and whole. He was a man of noble spirit and high culture. He numbered among his friends leaders in all walks of intellectual life, men such as George Lambert, Mark Hambourg and Percy Grainger. He moulded the thought of his time not by controversy, but by his transparent sincerity and by the simplicity and obvious rightness of his ideas. He could see through the trappings of a problem to its essential core as only great men can.

In choosing my subject, I have been dominated by the wish to give you something of my own, yet something worthy of the spirit of the man whose name we honour. I am at heart and by training an orthopædic surgeon. Later I became interested in gastric surgery. Then, for six years I devoted all my time to the surgery of warfare, a specialism in itself and one of no interest today. My fate has been that of most surgeons in the English-speaking world, whether we have been in the services or engaged in the less spectacular but equally important work of the home front. We have lost continuity. We have been unable to read, to attend meetings, to travel, to keep notes and records, to follow our cases. Yet during these years we have returned to the very foundations of surgery. We have studied trauma and

[1] Accepted for publication on March 18, 1947.

infection and the reaction of the healthy human body to these assaults in tens of thousands of cases, in which the same experiment, with endless small variations, has been repeated daily before our eyes. We should have been dull indeed if we did not learn some general lessons to help us in our own particular branch of surgery.

I shall therefore attempt to review my ideas on gastric surgery after an interval in which they have lain fallow. If I am unable to give you statistics, I take heart from Hamilton Russell himself, who said: "I shall even spare you the recital of my own statistics for the excellent reason that I have none. Frankly, I have never found myself able to conduct a long series of cases of any kind, even of the simplest, without occasional lapses and failure that would be ruinous to the statistics."

Surgical treatment has risks and disadvantages, which may be reduced by forethought, but which cannot be abolished altogether; it should therefore be undertaken only after these risks and disadvantages have been weighed against those of the natural course of the disease, or of any alternative

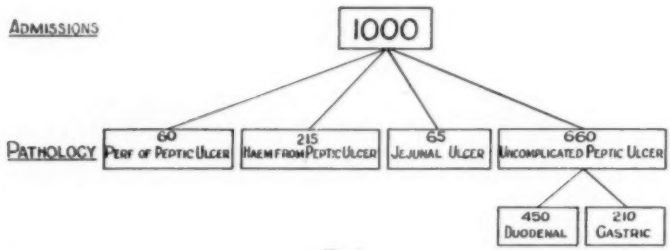

FIG. I.

DISTRIBUTION BY PATHOLOGY OF 1000 CASES OF PEPTIC ULCER ADMITTED TO HOSPITAL.

FIGURE I.

treatment, and found to be less. These considerations apply with particular force to the surgery of the stomach. Gastric cancer, if untreated, progresses rapidly to a distressing and painful termination, and no treatment other than operation offers hope, even of relieving pain or prolonging life. Gastric ulcer, however, is not necessarily a fatal or incurable disease. The victim has pain and indigestion and wants to be relieved, but he would rather keep his symptoms than lose his life. Physician and surgeon have the same threefold end in view, to relieve the ulcer symptoms, to heal or remove the ulcer, and to abolish the causes of ulceration.

Peptic ulcers occur only in those parts of the alimentary tract that are exposed to hydrochloric acid. They are usually limited to the segment between the cardiac orifice and the bile papilla, but they may be found in any part to which acid is abnormally introduced, by sphincteric deficiency in the œsophagus, by abnormal secretion, as in a Meckel's diverticulum containing oxyntic glands, or by operation. But though acid is a prerequisite to ulcer formation, it is not the cause. All God's children have acid, but animals never get ulcers, nor do the vast majority of men with hyperchlorhydria. Other factors must be at work. Ulcers are usually found on surfaces exposed to acid but secreting alkali, suggesting that their cause lies in a failure in the mechanism of protection rather than in excessive acid secretion. The association of excessive cigarette smoking with duodenal ulcer is admitted by all except the owners of tobacco shares and the addicts themselves. Toxins,

such as those of uræmia and sepsis, malnutrition, and trauma as at the constricting ring in a diaphragmatic hernia, play their part in the causation of gastric ulcer. The one factor that appears in all independent investigations is the psychological one; the really happy man seems to be immune from ulcer, however he maltreats his stomach.

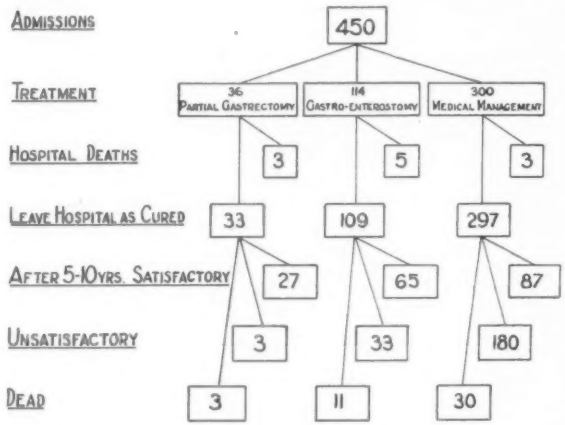

FIG. 2.

FATE OF 450 PATIENTS WITH DUODENAL ULCER WHO ENTER HOSPITAL

FIGURE II.

I have spoken thus far of peptic ulceration, but I will do so no longer, for no useful discussion is possible till it is admitted that duodenal and gastric ulcers, in spite of their anatomical and ætiological associations, are separate and distinct diseases. Duodenal ulcer is a new disease limited to civilized communities and to the more progressive members of those communities; gastric ulcer is an old disease seen in the under-nourished and underprivileged all over the world. Duodenal ulcer is becoming commoner, gastric ulcer rarer. Duodenal ulcer is common in men, usually brain workers of the restless, intellectual, worrying type; gastric ulcer is seen with equal frequency in both sexes, particularly in individuals who are tired, listless and in poor general health. Duodenal ulcer occurs in association with a small, high stomach placed transversely, showing marked tone, active peristalsis and rapid emptying, and a high acid curve; gastric ulcer is usually seen in those with a long, low stomach with poor tone and slow emptying, and a normal or low acidity. The first onset and subsequent relapses of duodenal ulcer can usually be traced to worry and overwork, the frustration of an ambition being responsible for both, with cold and excessive smoking often associated; no causes are as clearly linked with gastric ulcer, but oral

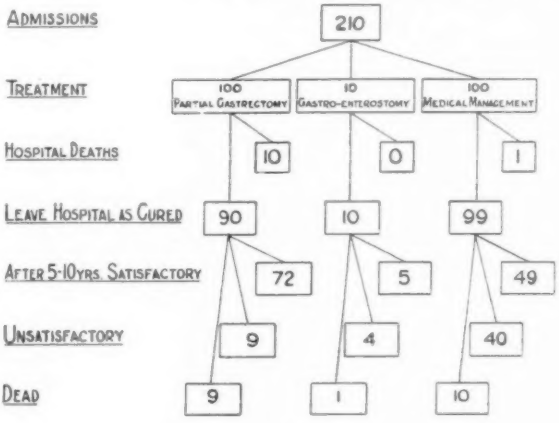

FIG. 3.

FATE OF 210 PATIENTS WITH GASTRIC ULCER WHO ENTER HOSPITAL.

FIGURE III.

sepsis and food of poor quality and insufficient amount seem often to be in part responsible.

Duodenal ulcers react well to treatment if the worry is removed and the smoking stopped, and remain healed if the causative factors do not recur. Gastric ulcers in their early stages heal with rest alone, but they have a greater tendency to become refractory. Duodenal ulcers have certain dangerous complications which are rare in gastric ulcers, perforation, stenosis and major hæmorrhage, but they never become cancerous. Gastric ulcers undergo malignant transformation in about 5% of cases; apart from this they are seldom fatal, but, once they have become chronic they rob life of all its pleasures.

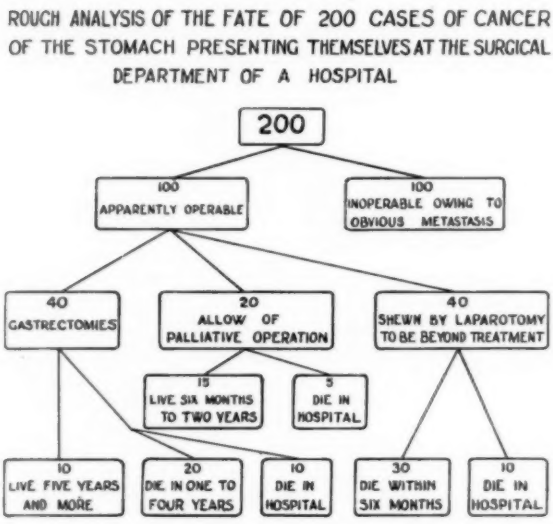
ROUGH ANALYSIS OF THE FATE OF 200 CASES OF CANCER OF THE STOMACH PRESENTING THEMSELVES AT THE SURGICAL DEPARTMENT OF A HOSPITAL
200
100 APPARENTLY OPERABLE
100 INOPERABLE OWING TO OBVIOUS METASTASIS
40 GASTRECTOMIES
20 ALLOW OF PALLIATIVE OPERATION
40 SHEWN BY LAPAROTOMY TO BE BEYOND TREATMENT
15 LIVE SIX MONTHS TO TWO YEARS
5 DIE IN HOSPITAL
10 LIVE FIVE YEARS AND MORE
20 DIE IN ONE TO FOUR YEARS
10 DIE IN HOSPITAL
30 DIE WITHIN SIX MONTHS
10 DIE IN HOSPITAL

FIGURE IV.

In general it may be said that in duodenal ulcer the causes of origin and of persistence lie in the psychological make-up of the patient and in his reaction to his environment, that is, in factors which no operation can control. In gastric ulcer, on the other hand, the causes of persistence, if not of origin, lie in the stomach itself, in the formation of an avascular scar that will break down, or of adhesions to neighbouring structures that will be dragged upon, whenever the stomach resumes its functions as a muscular mill. Thus we arrive at this simple rule: "Keep duodenal ulcers away from surgeons till their owners are forty-five or are suffering from complications, and take gastric ulcers away from physicians if they fail to remain healed after a year of medical treatment, or earlier if there are any grounds for suspecting that they may be malignant or likely to undergo malignant transformation." It is in these doubtful cases that gastroscopy by a skilled practitioner can often recognize the stigmata of malignant disease before any other method of investigation can give the answer, and eliminate a delay that may well determine the patient's fate. Operation, then, is the treatment of persistence in gastric ulcer, of complications in duodenal ulcer.

But even the separation of duodenal from gastric ulcer represents a view that is unduly simplified. During the past year I have put forward the suggestion that there are three clinical varieties of duodenal ulcer, which I have called duodenal ulcer A, B and C.

Duodenal ulcer A is the common type. It may start at any time during the period of stress, that is, between fifteen and forty-five years of age, but it usually makes its first appearance between twenty and twenty-five. It chiefly affects males, but whereas the proportion of men over women was formerly ten to one, today, when women are taking over men's jobs, men's

worries and men's habits, the proportion is about five to one. The site is in the first inch beyond the pylorus, usually on the anterior wall. The leading symptom is pain coming on in bouts, which seldom last less than six or more than twenty weeks. Each bout is heralded by malaise and is usually brought on by fresh worry or a fresh outburst of smoking; it takes a week or two to reach full intensity, and a week or two to subside. The pain has a definite relation to meals that for each ulcer follows a regular pattern repeated in attack after attack; it is relieved by alkali, by food and by vomiting. The ulcer may heal and remain healed if the worry is banished and the smoking stopped; otherwise it tends to give increasing trouble at shortening intervals. Ulcers of group A may perforate, but they rarely do so; they may bleed, but they seldom bleed profusely. If unhealed after repeated attacks they tend to go on to stenosis or to become refractory to all treatment.

Duodenal ulcer B is the ulcer that perforates. It is almost unknown in women. It is seen typically in men between the ages of twenty-five and thirty-five years who have had no previous history of ulcer, but have been well up to the time of the catastrophe or at most have felt off colour for a few days. At operation the perforated ulcer is found in the same position as ulcer A, but its appearances are those of an acute lesion; the edges are sharply punched, the surrounding duodenal wall is œdematous and offers little hold to stitches, there is no scarring or deformity, and the peritoneal coat is smooth and free from adhesions. The appearances tell the same story as the history, that the ulcer has been there for a few hours only, and suggest the view that its ætiology is different from that of ulcer A, that it is due to some event, embolic or otherwise, rather than to a long-continuing cause. That view is supported by the not infrequent association of acute perforating ulcers with septic conditions such as burns and appendicitis, and by their subsequent history. After simple closure about half of them are never heard of again; they give no symptoms and the perforation is not repeated.

Duodenal ulcer C is the ulcer whose dominant symptom is major hæmorrhage. It is seen typically in men between the ages of thirty-five and fifty-five years, that is, older than those who suffer from ulcers A and B. It is situated on the posterior wall of the duodenum at the junction of its first and second parts, burrowing in to the head of the pancreas and eroding the gastro-duodenal artery or one of its main branches. The symptoms are vague and sometimes absent. Bouts are characterized by a feeling of epigastric distension after meals and a desire to eructate rather than by pain. There may be a dull ache in the back unrelated to meals, and simulating renal pain. Most characteristic are the sudden severe hæmorrhages that come without warning and may end fatally. A common story is that a middle-aged man who has been feeling poorly for a few days is found in a state of collapse and is taken to hospital, where his colour and the state of his pulse point to a severe hæmorrhage. Hæmatemesis may show that the bleeding comes from an ulcer, but more often the nature of the catastrophe is betrayed by the passage of a bulky, dark stool containing two or three pints of altered blood. The mortality in ulcers of this type is 10% to 15% in any one attack, and the eventual mortality if operation is not undertaken is about 50%.

The surgical treatment of duodenal ulcer cannot therefore be standardized. For perforation, suture of the hole is in most cases all that is required and all that should be done; to add to an emergency life-saving procedure fancy steps designed to cure complications that may never happen is penny-in-the-slot surgery. For hæmorrhage the operation is seldom, and

for stenosis and chronicity never; an emergency one, and it must be planned with a view to permanent cure as well as present relief. Stenosis and persistence of symptoms in spite of conscientious treatment, which is an indication of scarring coming near to stenosis, usually follow prolonged ulceration. When they are encountered in men of fifty years of age, whose acid curve is low and remains low after repeated lavage, the operation of gastro-jejunostomy is usually satisfactory. It is safer and simpler than gastrectomy and in this group of cases gives permanent relief. If the history is a short one, if the stenosis is recent and therefore due in part to spasm and œdema, and if the patient is under fifty years of age, the risks of recurrent ulceration are considerable and gastrectomy should be undertaken.

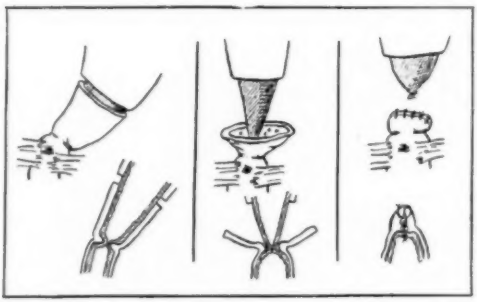

FIGURE V.

For major hæmorrhage gastrectomy is imperative, for complete exclusion of gastric contents can alone guarantee that secure and permanent healing of the ulcer on which future safety depends.

From the time the gastric efflux is excluded, a duodenal ulcer, however large it may be, however scarred, however recently it may have bled, will heal and remain healed permanently. Direct attack on the ulcer is unnecessary, and unnecessary surgery that may be difficult and dangerous is bad surgery. Many ingenious methods of closing the short stump of a scarred duodenum over the bed of a large posterior ulcer that has been exposed by bold but foolhardy dissection have been published. They show the ingenuity of their authors in overcoming difficulties that common sense should have taught them to avoid, and reminds me of the saying that "a wife is one who supports her husband in the trials that a bachelor never knows". If the duodenum can be cleared without difficulty for a full inch beyond the pylorus, and a tube sufficiently wide and soft left for infolding by a double layer of sutures, duodenal division is best. If it is grossly scarred and narrowed beyond the level of proposed section, if the inner wall is fused to the pancreas by fibrous tissue, and particularly if an ulcer can be felt in the posterior wall, no attempt should be made to dissect beyond the scarred area to normal tissues. The surgeon who attempts this is submitting his patient to a needless risk and will one day find himself in a situation from which there is no retreat. For such cases prepyloric section with removal of the mucous membrane as far as the pyloric ring is preferable. Only when bleeding is going on at the time of operation, that is, when the duodenum is seen to be full of blood, should a direct attack be made on the ulcer. Then the safest method is to inspect the bleeding point through a long anterior incision crossing the pylorus, to under-run the artery with silk sutures passed from within and then to trim the coats for safe closure. Those who rely on infolding the duodenal wall on to the ulcer bed to arrest a hæmorrhage that direct pressure of the thumb can hardly control, show a faith that I envy but cannot share.

In the treatment of gastric ulcer, gastrectomy, which at one step removes the symptoms, the ulcer and the dominant factor in ulceration, is the only entirely satisfactory operation; but because it is long and difficult, because

in unskilled hands it is dangerous, and because it involves the sacrifice of large amounts of normal tissue and the virtual abolition of gastric digestion, alternative methods of acid reduction have been proposed. Two particularly, vaso-ligation and vagotomy, are now before the surgical footlights, uncertain whether they will remain to receive bouquets or be dismissed with brickbats.

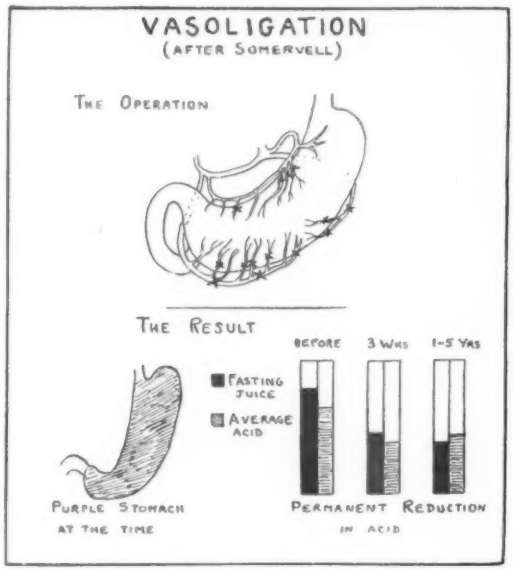

FIGURE VI.

Vaso-ligation was propounded ten years ago by Wilson Hey, of Manchester, and more recently has been advocated by Somerville. The operation is based on the assumption that occlusion of the arterial supply of the stomach to a point just short of gangrene will permanently reduce the secretory functions of the oxyntic mucous membrane. I have remained unconvinced by this reasoning and, being by nature cautious, I have feared to tread on paths that seem to me unsound when so many of my colleagues are prepared to rush in before me. Several London and provincial surgeons have performed vaso-ligation, but most have abandoned it because they found that the results were bad. Even in Manchester and India few have followed the lead of their colleagues. Hey and Somerville plod on alone, if indeed Hey has not already gone into reverse. It seems wrong in theory to expect that by cutting down the nutrition of an organ one of its functions can greatly be reduced without the others being affected, and wrong in principle to undertake an operation in which success depends on treading the razor edge between inadequacy and sloughing. Some vasoligators have lost patients in this second abyss.

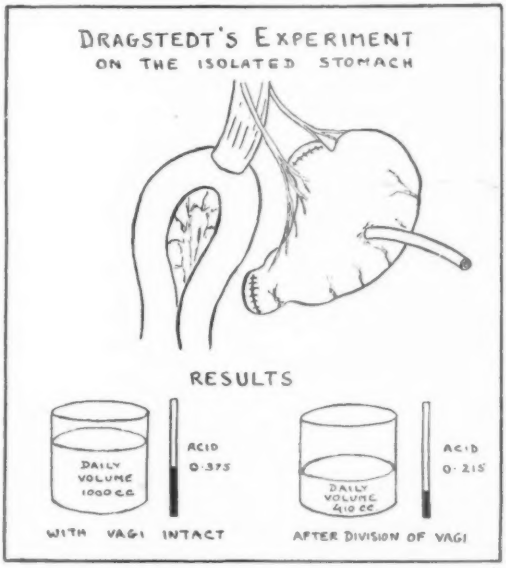

FIGURE VII.

Vagal section has been tried by many surgeons during the past twenty years. The majority have divided the vagi below the diaphragm, an operation that is usually incomplete. Dragstedt has advocated supradiaphragmatic section by a transthoracic approach. By joining the œsophagus to the jejunum in dogs, leaving the vagal innervation of the stomach intact, he has been able to study gastric secretion before and after vagal section. He found that by denervation the volume of juice secreted in twenty-four hours was reduced from 1,100 cubic centimetres to 410 cubic centimetres and the free

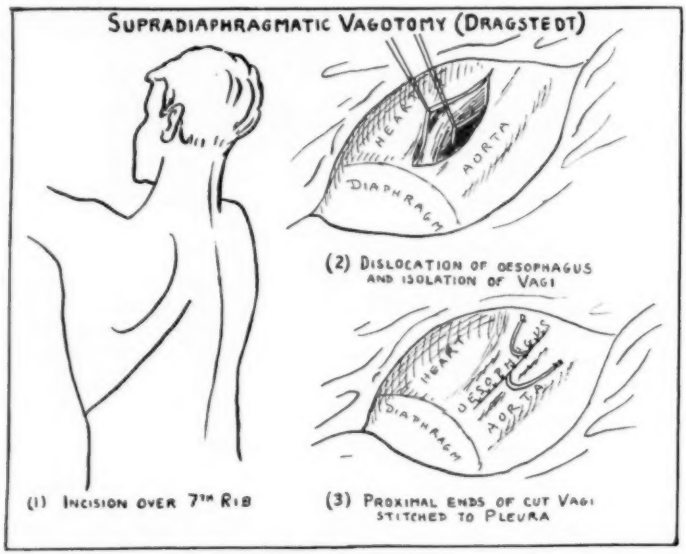

FIGURE VIII.

acid level from a mean of 0·385% to one of 0·215%. In a series of patients on whom the operation was performed, a striking and persistent relief of ulcer distress was obtained in nearly all.

Supradiaphragmatic vagal section brings a new and valuable weapon to the surgical campaign against peptic ulcer, probably no more than an accessory weapon, useful, like the flame-throwing tank, to eliminate pockets of stubborn resistance. It does not remove the ulcer or its secondary effects, scarring, deformity and adhesions. It reduces or abolishes mobility as well as secretion, and it cuts out one mechanism only in hydrochloric acid production, the nervous or psychic one. This mechanism is probably supreme in the dog, whose interest in food is unashamed, who does not smoke, has no repressions, and never gets ulcer. Man eats from habit rather than hunger, and the hormonic mechanism of acid secretion is probably dominant, and particularly dominant in the ulcer patient. Acid secreted in response to the sight of food is expended on the food; acid secreted as part of a hormonic misdemeanour pours out all the time and attacks the mucosa. The place of vagal section in the surgery of ulcers would seem therefore to be in the treatment of recurrences after radical operations in incurably ulcer-prone patients. Gastrectomy still holds the field as the safest, most certain and most controllable method of reducing the acid secretion to a safe level.

Three types of secreting glands can be distinguished in the stomach—the cardiac, the principal and the pyloric glands. The principal glands secrete pepsin and hydrochloric acid, the cardiac and pyloric glands a viscid alkaline secretion, one of whose functions is to protect the entrance and outlet of the stomach from the acid produced in its body. Meulengracht mapped out the areas occupied by these glands in the human stomach, which differ considerably from those in the pig. The principal glands occupy the fundus and body, but whereas in the fundus the mucous membrane is a single sheet studded with shallow crypts, in the body it is raised in thick rugæ which, in the excised stomach, look like the convolutions of the brain. An examination of the gross and microscopic appearances of the mucous membrane in these

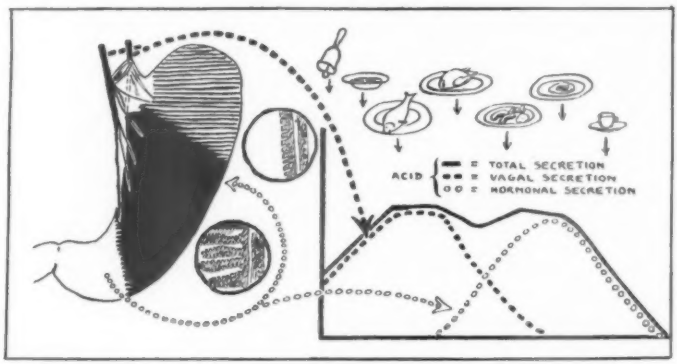

FIGURE IX.

two situations suggests that in secretory activity one square centimetre of mucous membrane from the body is equal to ten from the fundus. The pyloric glands occupy an area 2·5 to 3·0 centimetres proximal to the pylorus, extending further along the lesser than the greater curve. These glands increase in depth and complexity in the more distal parts of the stomach, and pass by transition into Brunner's glands of the duodenum, which appear to be lined by similar cells and to furnish a similar secretion. The pyloric-Brunner system extends in man as far as the bile papilla, though scattered glands of the same type may be found a few inches further down.

The mechanism of gastric secretion has been investigated mainly with regard to the flow of pepsin and hydrochloric acid and in dogs. The sight, smell and even the thought of food produces in the healthy man or animal an abundant flow of gastric juice. The early or psychic flow is stimulated by nervous impulses and is abolished by section of the vagi. The products of gastric digestion acting on the pyloric mucous membrane then produce a hormone which leads to a further flow of gastric juice. This secondary or chemically induced flow occurs when all the nerves to the stomach have been divided, and even in a transplanted gastric pouch.

A gastrectomy for the cure of ulcer should lower the acid secretion profoundly and permanently. It must therefore be radical, not necessarily in magnitude, but in the sense that it divides the three roots from which gastric acidity springs.

Firstly, it must remove the zone of high acid secretion. It matters little if it is a four-fifths gastrectomy, or if it goes up to the spleen; what matters is that it should remove the high convoluted mucous membrane of the body

and leave only the low acid secreting mucous membrane of the fundus. The part to be removed is thick and pink, with an obvious longitudinal muscular coat; the part that may be left is smooth and cream coloured, and the veins show through the even surface of the thin muscles.

Secondly, it must divide a high proportion of the vagal fibres reaching the stomach. The two vagi come through the diaphragm on the œsophagus and are distributed largely with the branches of the left gastric artery, cutting the corner to reach the lesser curve. The nervous, vascular and peritoneal connexions of the stomach should therefore be divided within an inch of the œsophageal opening in order to sever the neuro-vascular connexions and to allow the remaining portion of stomach to swing free.

Thirdly, it must remove the whole pylorus or at any rate the whole of the pyloric mucous membrane in which the hormone responsible for after-secretion is produced. There is considerable evidence that this chemically induced flow, going on when there is no food to digest, is the main factor in ulcer production, rather than the sharp bursts of nerve-summoned secretion called forth by food. There is more evidence that the persistence of this mechanism after operation is a potent factor in causing stomal ulcers after gastro-jejunostomy or gastrectomy. The purpose of after-secretion in normal digestion, if the frequent meals and repeatedly sated appetite of civilized man can be called normal, is clear. Food appears, and with it an outpouring of gastric juice to receive and digest it; then more food arrives, and gastric digestion is required long after appetite has gone. The hormonal mechanism serves to keep up the flow of gastric juice as long as any food remains in the stomach requiring digestion. The ulcer diathesis is characterized by the presence in the resting stomach of considerable quantities of gastric juice of high acidity and since it arrives without the call of food, without the sensation of hunger, and most characteristically during sleep, presumably the mechanism of its production is hormonal rather than nervous. After gastro-intestinal anastomosis it is rare for food to be found in the stomach more than half an hour after a meal unless the stoma is badly fashioned or has been scarred by ulceration. When the pyloric mucous membrane remains, as it does in gastro-jejunostomy and exclusion gastrectomy, unwanted acid is poured into an empty stomach and flows over an empty stoma so that gastro-jejunal ulceration should and does occur in a large proportion of cases.

Devine first advocated exclusion gastrectomy in 1925 as an expedient to overcome the difficulties of direct attack on callous ulcers of the posterior duodenal wall. In 1928 he reported thirty cases with three failures, in two of which the patients had jejunal ulcers. In 1936 I suggested preserving the pyloric antrum, not to avoid difficulties, but as an intentional step in an operation which I called physiological gastrectomy, believing that the retention of the alkaline secretions of this part of the stomach would abolish all fear of recurrent ulceration within two years. Nine out of twenty-two patients on whom the operation had been done returned with symptoms, eight of them with proved jejunal ulcers. I have since taken every opportunity to warn others of the dangers of leaving the pyloric membrane. Duodenal division and invagination is the best procedure when it can be done safely; otherwise prepyloric section of the muscular coats with excision of the mucous membrane right down to the pyloric ring, the operation published by Bancroft in 1932, is a satisfactory alternative.

Provided that the requisites for acid reduction have been satisfied by high resection, subtotal vagal division and pyloric excision, it is relatively unimportant how the alimentary channel is reestablished. After resection for gastric ulcer gastro-duodenal anastomosis is in theory preferable, for it retains the food in the stomach for a certain period of gastric digestion and

it pours the efflux onto a mucous membrane protected by Brunner's gland against the attack of acid. Gastro-duodenal anastomosis is satisfactory only where a long cuff of normal duodenum can be mobilized for anastomosis, and, therefore, unsatisfactory after gastrectomy for duodenal ulceration.

Eponymity is the curse of gastric surgery, for every operation has two or three fathers and the man who has established paternity is seldom the one who begat it. All gastrectomies are modifications of the Billroth I or Billroth II, and I shall trace only the ancestry of the two which I perform.

The original Billroth I had two defects, tension and a critical angle where the duodenum was joined to a large opening reduced to fit it. Von Haberer avoided the tension by a gastrectomy insufficient for acid reduction,

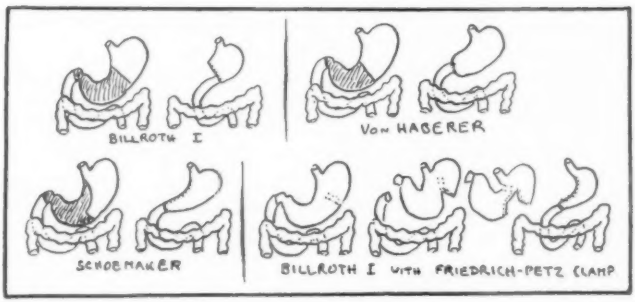

FIGURE X.

and abolished the critical angle by puckering up the cut stomach to duodenal size by a series of submucous sutures. Schoemaker, by making a cut at right angles to the greater curve equal to the diameter of the duodenum, and from it a curved one to the upper end of the lesser curve, was able to combine adequate resection with a stomach long enough to avoid tension and an end-to-end anastomosis. The Friedrich-Petz sewing clamp has allowed the performance of a gastrectomy of the Shoemaker type with greater ease, speed and safety.

The original Billroth II, in which the cut surface of the stomach was closed and a posterior gastro-jejunostomy performed, was soon replaced by anastomosis of the whole cut end of the stomach to the jejunum, an operation performed by Mikulicz, Kronlein, Hofmeister, Reichel, and finally by Pólya, who took the credit. Hofmeister closed the upper half of the opening to make anastomosis easier in large stomachs. Lake in 1928 and Finsterer shortly afterwards introduced valvular gastrectomy. Lahey originated the very simple device of straightening out the duodeno-jejunal flexure and bringing the whole anastomosis above the mesocolon.

I dislike antecolic anastomoses, except in the case of a palliative operation for cancer, because they lead to tension on the stoma when the resection of stomach is adequate. Surgeons who favour the anterior operation speak of using a 12, 14 or 18 inch loop of jejunum; but the length of a loop is not that of the bowel, but that of the arteries, which in the jejunum never exceed and seldom attain a length of four inches. I dislike the full-width anastomoses of Pólya, Balfour and Moynihan, and dislike even more the reduced but non-valvular stoma of Hofmeister. The commonest cause of death in the immediate post-operative period is disruption of the duodenal stump, and the commonest cause of post-operative dysfunction is proximal loop distension, a danger and a sequel that can be avoided only by a valvular anastomosis.

The gastrectomy I perform for duodenal ulcer is therefore a retrocolic valvular one, a Lake-Lahey-Billroth II. After the stomach has been divided between two rows of metal sutures inserted by the Petz machine, the proximal part of the cut edge is infolded to within two fingers' breadth of the greater curvature. It is unnecessary to make a stoma larger than the jejunum with which it communicates. The anastomosis is made in the usual manner, and

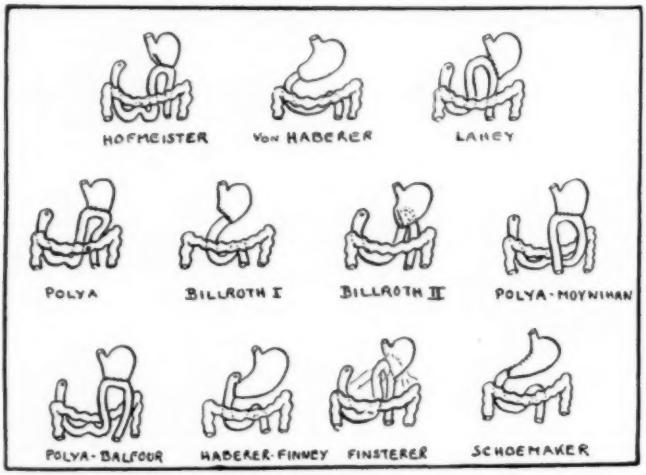

FIGURE XI.

the jejunum above it is hitched up to the whole length of the closed lesser curvature, so that it lies in an easy loop. Such a result cannot be attained by an anterior anastomosis, nor is it possible if the Finsterer technique of suturing the mesocolon to the stomach is followed, for the jejunal loop is then forced down and deformed by a tight mesocolic tent. The duodenal-

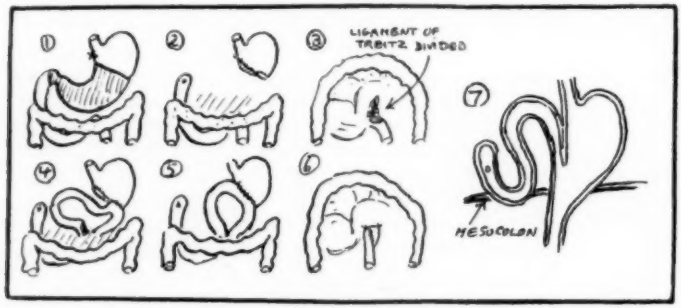

FIGURE XII.

jejunal flexure is therefore dissected free from its upper peritoneal attachments and the mesocolon is incised for two inches in the bare and avascular area thus exposed. A generous loop of jejunum, ten to twelve inches long, is pulled through this opening, anastomosed to the stomach, and above the opening applied to the closed lesser curve by a series of stitches that take a double bite on its antimesenteric border and a bite on each side of the

gastric suture line. The final result is that the duodeno-jejunal flexure lies above the mesocolon and the jejunum flows in an easy curve up to the right of the œsophageal hiatus and then down along the stomach, the stoma being nearly vertical and lying in the mesocolic opening, where it is held by a single stitch.

I must finish where I began. Gastric surgery is difficult and dangerous, and fails to attain what should be the goal of all treatment, the restoration to normal. Gastrectomy is quite frankly a physiological crime, for it abolishes almost entirely and quite permanently one of Nature's most important defences and dumps food into the intestine almost as it leaves the mouth. If the first defences of normal man are lacking—teeth, common sense and a good wife—the food may travel down the œsophagus and through the curtailed stomach in a condition quite unfit for further digestion. But while gastrectomy is an impertinence, it is at the present time the most satisfactory cure for persistent peptic ulceration and is able to restore a wasted and miserable patient to health and happiness.

ACKNOWLEDGEMENT.

For Figures I, II, III and IV (there were three or four figures for gastric and duodenal ulcer which arrived before the lecture and were spliced into the microfilm) I am indebted to my former house surgeon, Donald M. Douglas, M.S., F.R.C.S., of the Department of Surgery, University of Edinburgh.

CARCINOMA OF ŒSOPHAGUS AND CARDIAC END OF STOMACH.[1]

By Leo Doyle,
Melbourne.

Until quite recently carcinoma situated in the œsophagus or the cardiac end of the stomach had been defeated surgically on but very few occasions.

Torek in New York was the first to remove an œsophagus successfully, and his success was responsible for the birth of the Torek operation—a method which had in it the elements of success, but required from the surgeon much preparation, work, care and skill, and from the patient strength and good fortune, characteristics lacking in sufferers from this disease. Edgar King, of Melbourne, as the result of much work probably had as good results as any in this field of strenuous surgical endeavour. The Torek operation, however, even when successful, suffered from the great disadvantage that it altered the line of food delivery from the inside of the thoracic cage to its front, and provided, instead of the œsophagus, a skin-lined tube totally deficient in muscle, which relied entirely on gravity to propel the food into the stomach. This tube, in addition to being inefficient, required for its completion one or more operations which were difficult and not always successful.

This was how the matter stood until recently, when rather great advances in various directions had improved the mechanics and æsthetics of the operation as well as the patient's chance of surviving.

Not the least of these advances is that of anæsthesia. After I had struggled with intratracheal ether and with local anæsthesia in attempts to achieve this operation my introduction in other chest cases to controlled respiration anæsthesia with cyclopropane made me realize that this was the method that would probably make œsophagectomy a practicable procedure.

Chemotherapy with the sulphonamides and penicillin removed, to some degree, the tremendous obstacle of post-operative infection, and so another source of anxiety and probable failure was overcome. The realization of the importance of adequate pre-operative treatment made it possible for the patient to approach operation with all his deficiencies (hæmoglobin, plasma protein, water and vitamins) made good. Thus the bugbear of insufficient healing capacity was overcome.

Kirschner made the original discovery that the whole stomach could live on the blood supply it got from the arteries at its pyloric end alone. Garlock found that by dividing the gastro-hepatic and gastro-colic omenta and the left gastric artery the stomach could be converted into a long muscular tube which, when the diaphragm had been divided outwards from the hiatus, could be stretched almost to the top of the pleural cavity. In this fashion it was possible to anastomose the stomach to the œsophagus at almost any level in the chest. He found it a matter of practical surgery to dislocate the œsophagus from its posterior position and to bring it anterior to the aorta, and he found that this manœuvre would, in a high resection, simplify an œsophago-gastrostomy.

[1] Accepted for publication on December 17, 1946.

Phemister had previously found that a trans-thoracic, trans-diaphragmatic approach gave excellent access to the stomach and made it possible to resect a carcinoma of the body and cardiac end as freely as it had been possible to resect those of the pyloric end.

The trans-thoracic approach varies with the site of the carcinoma and the rib resected depends whether one wishes to attack a high carcinoma of the œsophagus (that is, one situated just below the bronchus) or the stomach. The bed of the seventh rib is the best approach for the higher lesion of the œsophagus, the bed of the eighth for the œsophageal carcinoma situated just above the hiatus, and the bed of the ninth for a gastric carcinoma. In the case of the last-mentioned, it is probably better to make a subcostal incision across the rectus belly between the eighth and ninth intercostal nerves and through this to expose the stomach and liver to determine the operability. If the lesion is operable the incision is extended out over the ninth rib and this is resected from the costal arch to the angle. In cases of œsophageal carcinomata, exploration through the left side of the chest should be done for those tumours that lie caudal to the left bronchus; if they are above this level they are probably better attacked through the right side of the chest.

When the chest has been opened it is usually possible to feel the lesion immediately, but on occasion it will be necessary to free the œsophagus before this can be done. The mediastinal pleura overlying the œsophagus is opened and the organ is found. It is freed and a tape is passed round it. Both trunks and branches of the vagus will be divided while this is being done. When the œsophagus has been freed and the tumour isolated, an attempt is made to see where the anastomosis will have to be done in order to obtain an adequate excision of the tumour. If this is very close to the bronchus, it is better to dislocate the œsophagus and to make it lie anterior to the arch of the aorta. This is a fairly simple manœuvre, the œsophagus being held taut by the surrounding tape and freed by a finger working in the plane around it. When well above the aorta, the working finger is pressed outwards against the pleura, which is then opened at this spot. The finger is then withdrawn from below the aorta, this pleural opening is enlarged, the finger is passed into the opening and the œsophagus is freed to a higher level. When the œsophagus has been freed, whether at this high level or not, as demanded, the diaphragm is split radially from the hiatus. Some trouble may be found with the phrenic arteries, but this is easily overcome. The stomach is then freed along both curvatures by dividing the left gastric and left gastro-epiploic arteries, care being taken to see that the arterial branches coming from the right end of the stomach are not interfered with.

When the stomach is free, the œsophagus is divided at the cardiac orifice and the stomach is closed. The divided end of the œsophagus is sealed in some suitable way and traction is exerted on it. The stomach is then brought up behind the œsophagus until the appropriate site for the œsophago-gastrostomy is arrived at. Whilst the tension on the œsophagus is kept up, the posterior two layers of interrupted, non-absorbable sutures are inserted, the stomach is then opened and the œsophagus cut across and a continuous mucosal catgut suture inserted. The two anterior, non-absorbable suture layers are then inserted and the anastomosis is thus completed. The stomach is then fixed by being sutured to the pleura of the paravertebral gutter and to the mediastinal pleura if possible. The diaphragm is then closed with interrupted silk or cotton sutures, care being taken to close the gap snugly, but not too tightly, around the stomach, to which it is also sutured. The pleural drain is then placed in position and the chest closed.

In doing a total gastrectomy, the œsophagus having been divided well above the lesion, it will frequently be found that the œsophago-jejunostomy will lie in the chest.

These operations are extensive, take much time, and are not possible unless all the assistance given by correct anæsthesia and adequate resuscitation methods are available. Even then there will be quite a large mortality at first until the operator becomes more skilful. The patients requiring this operation are doomed unless something can be done, and now the way is known, more and more should be attempted. The œsophagus will probably be the organ with the better prognosis, as its lesions give early notice of their presence, in contradistinction to the stomach, lesions of whose cardiac end are notoriously far advanced before they are diagnosed.

The following is the case history of a man for whom this operation was successfully carried out.

CASE I.—Mr. F., aged sixty years, had in one week two great strokes of fortune—one good and one bad. Almost simultaneously with the arrival of the news that he had won Australia's oldest "consultation"[1] came the discovery that he could not swallow any meat. He asked his doctor's aid in being identified at the bank and at the same time discussed his recent inability to eat successfully. The doctor identified him legally and then sent him to a radiologist for an investigation. Dr. John O'Sullivan's report was as follows:

> *Barium Swallow.* The films made show marked narrowing of the œsophagus over a length of about one and a half inches in the lower third. Above this level the œsophagus is a little dilated and tapers down smoothly to the narrowed area. There was some obstruction to the passage of the barium at this level.

The appearances suggest probably carcinoma of the œsophagus. (See Figure I.) He was at this stage admitted to the Mercy Hospital, but, having developed a cold, was sent home. He was again admitted and œsophagoscopy, performed by Mr. Raymond Hennessey, disclosed a stricture associated with spasm, but no ulceration could be seen. A biopsy was taken from the apparently normal œsophageal wall at the site of the stricture. The pieces removed were reported by Dr. A. J. Brenan as follows:

> Two of the three tiny pieces sent do not show any evidence of malignancy. The third piece has a well-defined surface epithelium on one side, which shows some thickening in one or two places. At the depth of the tissue there are some small, irregular masses which appear to be close to some ? muscle. This area is suspicious of malignancy.

The patient was in excellent condition, as shown by his blood investigation, which gave the following results: hæmoglobin value, 95%; plasma protein, 6·7%; total chlorides, 573 milligrammes per 100 cubic centimetres of plasma.

At this stage the diagnosis and prognosis were told to the patient. The possibilities of treatment—medical, palliative and radical—were explained, with the eventual outlook attached to each, and the patient then elected to have radical treatment.

On December 14, 1945, at Mercy Hospital, Melbourne, controlled respiration anæsthesia with cyclopropane and oxygen was given by Dr. R. Orton.

The patient was fixed in position lying on his right side. A long incision was made along the line of the eighth rib, running from just medial to the angle forward to the costal margin. The superficial muscles were divided and the ribs exposed. The seventh rib was then resected from the angle to near the costal margin, and from the two higher ribs small pieces were resected just medial to their angles. The pleura having been opened, the lung was retracted and an attempt made to feel the tumour. A gland was palpated and then a way into the œsophagus was made by dividing the pleura overlying it. With some difficulty the œsophagus was freed and eventually the tumour located. It was discovered as a hard, indurated mass which lay just caudal to the left bronchus. The location of the tumour was such that division of the œsophagus at a level reasonably distant from the tumour would require the subsequent anastomosis to be performed behind the bronchus. It was decided to dislocate the œsophagus from behind the aorta and to bring it anteriorly so that the anastomosis might be done in a reasonably accessible area. The œsophagus was therefore freed from its bed as far up as possible and then the pleura, lying cranial to the aorta, was opened and the œsophagus reidentified.

[1] This refers to a well-known lottery sweep.

At this stage, when the œsophagus had been isolated in its bed, but was still attached above and below, the diaphragm was opened radially from the hiatus. The œsophageal preparation was continued into the abdomen by opening into the lesser sac, and the stomach was freed almost down to the pylorus. The œsophagus was clamped at the cardiac orifice and divided, and the proximal end was covered with a rubber glove. The distal end was inverted into the stomach with interrupted cotton

FIGURE I. Skiagram showing the location of the lesion in Case I.

FIGURE II. Case I. Skiagram showing the thoracic stomach some months after operation.

sutures. The freed œsophagus was now brought up behind the aorta and pulled anteriorly to it. The freed end of the œsophagus was used as a tractor to overcome the tendency to contraction, and the fundus of the stomach was placed behind the site elected for anastomosis. By a two-layer suture line consisting of interrupted cotton stitches the œsophagus was inverted into the fundus of the stomach and the stomach was then stitched to the posterior pleura of the paravertebral gutter. The diaphragm was then closed down to the stomach with interrupted sutures of silk and cotton, and the phrenic nerve was lightly crushed. The stomach was sutured to the edge of the opening in the diaphragm. A Winsbury White tube was passed through the tenth intercostal space and plugged with a spigot. The ribs were brought together with pericostal sutures of strong silk and the pleura was closed with interrupted cotton sutures. The superficial thoracic muscles were closed with interrupted cotton sutures and the skin with Michel clips. The patient was transferred to the ward, where the tube was connected to a suction apparatus and constant suction at a pressure of a few centimetres of water was kept up. The transfusion, which had been started before the operation, was kept going and later glucose and saline solutions were given intravenously to maintain a fluid balance. The patient's condition was always completely satisfactory and never gave any cause for alarm. He was drinking water by mouth, in small quantities, by the fifth and sixth days. He was gradually put on a

fuller diet and left hospital about three weeks after his operation. A barium swallow given just before he left (Figure II) was reported as follows:

> Screening shows a fluid level about the centre of the left side of the chest—fasting fluid in the stomach, the greater part of which has been drawn up into the posterior portion of the left side of the chest. The œsophagus turns sharply to the left across the top of the aortic arch, at the level of which it is anastomosed to the stomach. Barium passed freely through the anastomosis. There is no evidence of any significant fluid in the left hemithorax.

The specimen was unusual, for when cut open it presented no ulcer, but merely a rigid thickening of the œsophagus. It was sectioned and Dr. A. J. Brenan's report is as follows:

> *Epithelioma.* Irregular masses and strands of tumour cells spread right through the wall to the outer coat.
>
> *Lymph Gland.* There are extensive epitheliomatous deposits throughout the gland.

The patient, after leaving hospital, gradually improved and is now gaining weight, and when last seen, ten months after operation, said he was very well and swallowing

FIGURE III. The position of the patient on the operating table. Additional stability is achieved by the use of sandbags.

easily. An X-ray examination at this time showed the œsophagus to be working well, but the stomach was apparently atonic.

A second case illustrated that, even if one can steer a sick and elderly patient through a major operation by relieving him of his deficiencies, the permanently damaged tissue of older troubles will still be a liability which cannot be overcome and which will rob the surgeon of success when it is apparently safe in his hands.

CASE II.—Mr. F.D., aged seventy-seven years, had had most of the troubles that occur to man. In his youth he had had pulmonary tuberculosis and a tuberculous larynx. He kept silence for two years and recovered with a damaged larynx and a harsh voice, which made his speech difficult to understand. As an enthusiastic and, I am informed, very skilful horseman, he had broken most of the usual bones, and on one occasion had the lower part of the left side of his chest stove in. He had apparently a hæmothorax, which was drained as an empyema. He was a chronic bronchitic and suffered from repeated attacks of heart failure with pulmonary œdema.

Whilst in Sydney, he ate oysters which, he said, were bad, as he could not swallow them. He saw a physician, who had him examined by X rays, with a result that exonerated the oysters and showed him to have an undoubted carcinoma of the œsophagus.

The nature and consequences of this lesion were pointed out to him, and later a consultation with Dr. R. L. Fulton, his family physician, and Dr. L. Hurley was held and it was decided that an attempt should be made to resect the œsophagus. The patient thought this over for a few days, but his dysphagia increased rapidly and he decided to go on with the radical operation. He had a preliminary enterostomy on April 30, 1946, so that his fluid balance might be reestablished, and he was given feedings with a high caloric value and a high protein content. His blood investigation

yielded the following information: hæmoglobin value, 90%; total protein content, 7%; chloride content, 480 milligrammes per 100 cubic centimetres; urea content, 96 milligrammes per 100 cubic centimetres. He was given a blood transfusion and on May 10, 1946, a radical operation was done.

The anæsthesia was again controlled respiration with cyclopropane and oxygen given by Dr. Bridges Webb.

A long incision along the line that would normally represent that occupied by the eighth rib disclosed a network of bones, the end result of his past injuries and surgery.

As much as was necessary of this was removed and sections were cut from the vertebral end of the seventh and sixth ribs. There was no pleural cavity, but there was an easily stripping layer of areolar tissue surrounding the lung. The lung was freed fairly easily and access was obtained to the posterior mediastinum. Dissection

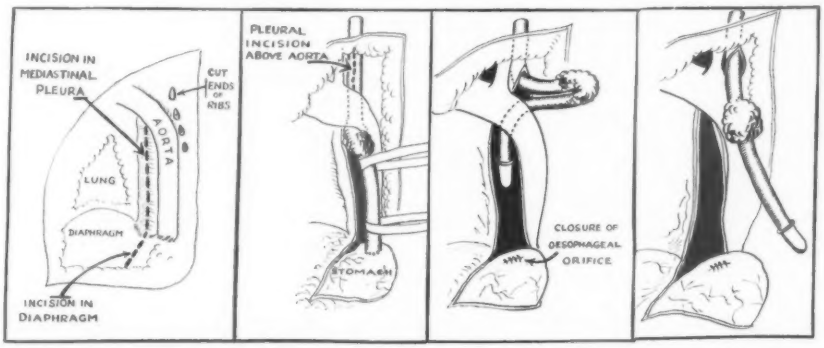

FIGURE IV. Diagrammatic representation of the area.

FIGURE V. The œsophagus has been freed below the aorta and controlled with tapes.

FIGURE VI. The œsophagus has been freed above the aorta and is being dislocated to lie anteriorly.

FIGURE VII. The œsophagus freed and lying anteriorly to the aorta. Note distal end is covered by rubber cap.

here revealed a dilated aorta and a slightly dilated œsophagus with a tumour, cartilaginous to the feel, spread over one to one and a half inches of the organ and lying below the bronchus. The œsophagus was freed and secured by tapes passed around it. The diaphragm, which was adherent to the costal cage, was opened down to the hiatus. The stomach was freed by ligating the various omenta and the left gastric artery, and was then pulled up through the diaphragm to the site of the tumour. The œsophagus was divided at the cardiac orifice and this was closed. The œsophagus was then laid on the stomach and a two-layer anastomosis was done, the œsophagus being inverted into the stomach. That portion of the œsophagus below the line of anastomosis (about five inches) was removed. The stomach was sutured in the paravertebral gutter and the diaphragm was closed around the stomach. The thoracic musculature was closed over the rib deficiency, a small drain being passed into the peripneumal space. Glands palpated with the tumour were removed with it. Dr. A. J. Brenan sectioned the tumour and his report is as follows:

> Portion of the mucous membrane is papillary with some of the papillæ covered by a layer of epithelial cells like poor type tall epithelium. Others are covered by several layers of epithelial cells. The tumour is a carcinoma and consists of infiltrating masses and strands of epithelial tumour cells spreading deeply through the wall. Some areas show pseudo-mucinous change. Large nodule in fibro-fatty tissue is nearly a mass of carcinoma showing extensive pseudo-mucinous change.

The patient recovered satisfactorily from the anæsthetic and had quite a good night. However, next morning he had a sudden seizure and died in a few minutes.

The lesson learnt from this patient was that old age and general condition did not prevent a patient from recovering from an anæsthetic after having undergone a long operation, in which he did not exhibit any of the usual signs associated with surgical shock.

TOTAL GASTRECTOMY.

The same approach will give access to the cardiac end of the stomach and renders the operation of total gastrectomy a much simpler affair. The upper approach through the open diaphragm gives good access to the spleen, which should nearly always be removed, as it is inclined to obstruct the view, and its absence also tends to make the subsequent repair easier. On occasions, with the spleen, the tail of the pancreas can also be taken.

The possibility of removing part of the colon may determine whether or not a tumour is operable and this is also possible. In some cases the pyloric

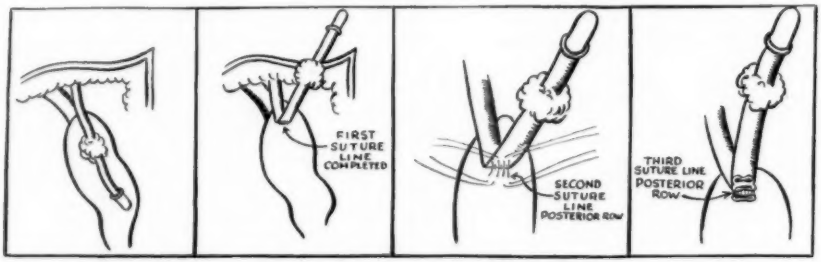

FIGURE VIII. Illustration of first steps in the œsophago-gastrostomy. Note that the submucous layer of the œsophagus is the important layer for its suture. It corresponds to the serosa of the stomach.

end of the stomach may be a little distant for easy and accurate suturing and when this is so the incision can be extended through the costal margin out into the left rectus between the eighth and ninth intercostal nerves.

CASE III.—The following is the history of Mrs. D.B., aged thirty-eight years.

Eighteen months previously the patient began to experience difficulty in swallowing her food. This difficulty was felt at the lower end of the sternum, where she would feel her food "stop". She had no difficulty at the upper end of the œsophagus. Solid foods would appear to her to stay in the lower end of the gullet for some hours. Periods of freedom from this complaint were noticed, however. Loss of weight over the preceding three months amounted to one stone; also some pain was felt at intervals in the epigastrium. Anorexia occurred at odd intervals, although if the patient felt like eating, she was unable to do so. Four months after the onset of the illness the patient sought medical advice and was given "acid" which afforded her no relief. Eight months after onset an X-ray examination was made (cholecystogram). Cholecystectomy was performed on October 1, 1945, and during her convalescence she developed a femoral thrombosis. The swelling disappeared after five or six weeks.

In the last few months her difficulty in swallowing became more marked and at the time of her admission to hospital she could swallow liquids and semi-solids only. Vomiting occurred at times after she had eaten solid foods.

General inspection showed an extremely wasted woman, who was able to swallow even water only with the greatest difficulty. Her abdomen was very wasted; there were prominent veins round the umbilicus and a well-healed scar of a Kocher incision. No mass or viscus was palpable. She had slight tenderness on deep pressure in the epigastrium.

An X-ray report by Dr. Leo King was as follows:

> *Barium Swallow.* Screening three hours after taking the barium showed that a considerable amount of the substance was present in the lower end of the œsophagus. Superficially, the appearance resembled a cardiospasm, but in the narrowed lower end of the œsophagus a distinct filling defect was found which, from the nature of the patient's diet, is most unlikely to have been due to food. Careful examination of the upper end of the stomach was therefore made. The barium passed, with some obstruction, but nevertheless reasonably, into the stomach, as some of the films show. There was an irregularity of the medial part of the stomach extending from the lower end of the œsophagus, involving the fundus and passing downwards for about three or four inches, terminating in a projection somewhat like a gastric ulcer.

Conclusion. There is an extensive neoplasm involving the lower end of the œsophagus, the fundus of the stomach, afterwards extending along the lesser curvature. It is quite likely a carcinoma. I should say in any case that it is definitely malignancy. Conclusion: carcinoma.

Examination of the blood yielded the following information: red cell count, 3,390,000 per cubic millimetre; hæmoglobin value, 65%; colour index, 0·9; white cell count, 7,200 per cubic millimetre.

Chemical examination of the blood yielded the following information: urea content, 25 milligrammes per 100 cubic centimetres; chloride content, 491 milligrammes per 100 cubic centimetres; protein content, 6·8%.

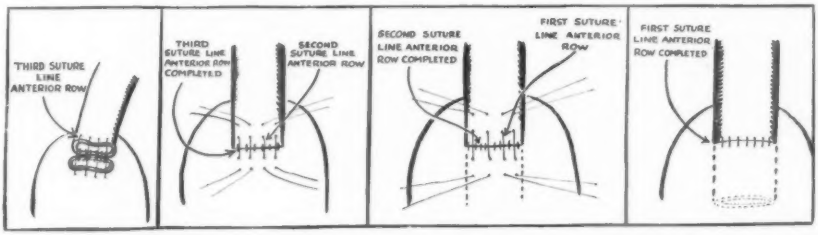
THIRD SUTURE LINE ANTERIOR ROW
THIRD SUTURE LINE ANTERIOR ROW COMPLETED
SECOND SUTURE LINE ANTERIOR ROW
SECOND SUTURE LINE ANTERIOR ROW COMPLETED
FIRST SUTURE LINE ANTERIOR ROW
FIRST SUTURE LINE ANTERIOR ROW COMPLETED

FIGURE IX. Further steps in the anastomosis. Note that mattress sutures should not be used in the œsophagus for fear of limiting an already poor blood supply.

The patient was given a transfusion; five pints of blood were given, which increased her hæmoglobin value to 100%.

At this stage total gastrectomy was performed, controlled respiration anæsthesia with cyclopropane and oxygen being administered by Dr. Orton.

At operation an incision was made from behind the spine of the scapula posteriorly around to the left hypochondrium; the eighth rib was resected and the diaphragm exposed. The phrenic nerve was then crushed, the diaphragm cut through and the peritoneal cavity opened. There was an extensive carcinoma of the cardiac end of the stomach, extending along the lesser curvature, and some glandular involvement. It had also involved the lower end of the œsophagus. The liver showed no evidence of secondary deposits and there was no free fluid in the peritoneal cavity.

In order to mobilize the stomach it was necessary to remove the spleen and the tail of the pancreas.

The œsophagus, with the involved glands, was then divided about an inch from its entry into the stomach, which was then deflected to the left side and divided near the pylorus. After the stump had been sewn over, a loop of the jejunum was then brought up and anastomosed to the œsophagus (end-to-side anastomosis). A few inches below the œsophago-jejunostomy a jejuno-jejunostomy was carried out. The anastomosis was done according to the technique of Roscoe Graham. The diaphragm was then reconstituted around the anastomosis, the incision was closed and a drain tube was inserted into the pleural cavity.

The post-operative convalescence was, on the whole, satisfactory and was marred only by an attack of diarrhœa. The patient was fed with hydrochloric acid and peptonized milk and this then cleared up.

She eventually became sufficiently strong to leave hospital on the thirty-first post-operative day.

This patient did well for a while after operation and for a while gained weight. She suffered from a recurrence, however, and died some seven months after operation. No autopsy was obtained.

CASE IV.—Mr. C.B., aged seventy-four years, gave the following case history. Six months ago he began to experience lower substernal discomfort after meals. Food would appear to be held up at the lower end of the gullet. This feeling would appear at irregular intervals; he might have freedom from the complaint for some days. No actual vomiting occurred. Loss of appetite was noticed at this time. Six weeks ago he was able to swallow liquids only. He had no severe pain, however. He had lost two stone in weight for no apparent reason.

Four months ago he was examined by X rays with a "query negative" report. There was no mass or viscus palpable in the abdomen nor any distension of veins.

Œsophagoscopy, carried out by Dr. Leonard Johnston, disclosed a scirrhous carcinoma of the lower end of the œsophagus. There was no ulceration or fungation.

An X-ray report by Dr. E. Biggs was as follows:

> *Barium Swallow.* There is an obstruction at the lowermost end of the œsophagus with a very little dilatation above it. Barium passes through, but only in a very fine stream with irregular edges. The appearances indicate carcinoma of the lowermost part of the œsophagus.

The report on the blood was as follows. The hæmoglobin value was 85% and the blood group O IV. The blood urea content was 31 milligrammes per 100 cubic centi-

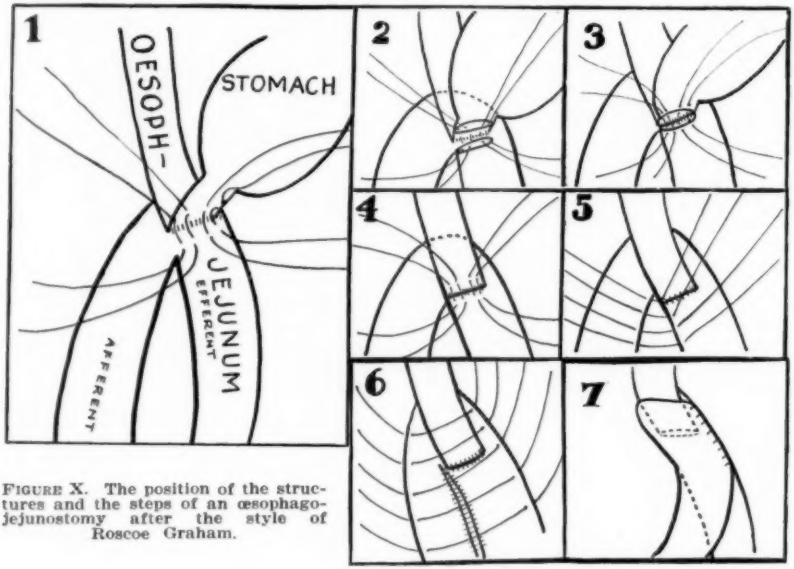

FIGURE X. The position of the structures and the steps of an œsophago-jejunostomy after the style of Roscoe Graham.

metres; the chloride content was 491 milligrammes per 100 cubic centimetres; the protein content was 5·7%.

Blood transfusion was carried out and on March 21, 1946, under controlled respiration anæsthesia and oxygen administered by Dr. Bridges Webb, operation was performed as follows.

An incision was made from the spine of the scapula around to the upper left hypochondrium; the greater portion of the eighth rib was resected and the pleural cavity was entered. The left leaf of the diaphragm was then divided and the peritoneal cavity opened.

The stomach was found to be the site of an extensive carcinoma which had spread to adjacent glands and was adherent to the transverse colon. The stomach was freed as far as possible from the posterior wall, but in the region of the pylorus indurated tissue had to be divided in order to achieve this. The transverse colon could not be separated from the greater curvature, so a portion of it was resected. The stomach was then divided in the region of the pylorus and the œsophagus was also divided near its lower end. The stomach, together with the tail of the pancreas and spleen, was removed.

A loop of jejunum was then brought up and anastomosed to the œsophagus. A few inches below the anastomosis a jejuno-jejunostomy was performed. The resected colon was anastomosed end to end. After the diaphragm was reconstituted around the œsophagus, the pleural cavity was closed with a drain tube in it.

The histological report by Dr. Brenan on the specimen was as follows:

> The portion of the stomach sectioned had an ulcerated surface and the structure beneath it is like that of a *linitis plastica* with isolated (?) tumour cells in the submucous layers down to the muscle. The wall is greatly thickened.
>
> Of three glands sectioned, two show hyperplasia and one shows a marginal deposit of carcinoma, some areas of which are poor type. Adeno-carcinoma.

On the ninth post-operative day the patient developed diarrhœa. This became rather bad, but unfortunately, in my absence and that of my regular house surgeon, its importance was not appreciated. The patient became dehydrated and deficient in protein and died on the seventeenth post-operative day.

At autopsy the suture lines were well healed; there was no sign of infection or metastases anywhere.

The patient's death was a chemical one and possibly could have been averted if correct intravenous medication had been undertaken.

CASE V.—Miss O.C., aged forty-five years, arrived with a letter from a surgeon in another State, in which it was stated that a laparotomy had disclosed a carcinoma of the stomach so advanced that its removal would have required a total gastrectomy. On exmination she looked pale and ill and had a well-healed transverse laparotomy scar. Her hæmoglobin value was 70%—9·8 grammes. Her total blood protein was 5·8 grammes and her blood chloride content 600 milligrammes per 100 cubic centimetres. She was given three pints of blood and her hæmoglobin value became 95%. Operation was decided on. A further transfusion was started during operation, and in the next four days she was given four pints of blood in addition to glucose and saline solution.

The approach was transthoracic, through the bed of the eighth rib. The diaphragm was incised immediately and the stomach explored. The original site of the tumour was near the pylorus, but it had spread so far subperitoneally towards the cardiac end that a total gastrectomy was required for its complete removal. This was achieved in the usual fashion, but the costal margin had to be divided and the incision prolonged into the abdomen in order to achieve reasonable access to the duodenum for its division and closure. When this incision is prolonged, the division of the diaphragm is carried on into the *transversus abdominis* muscle and the posterior sheath.

When the stomach and the great omentum had been removed an end-to-side œsophago-jejunostomy was done, the technique of Roscoe Graham being followed. The closure was then begun by stitching the sheath of the rectus and the diaphragm with interrupted silk.

The chest was closed with interrupted pericostal sutures of steel wire and the muscles were sutured with interrupted cotton sutures.

No drainage was used and the convalescence was uneventful.

Subsequent to leaving hospital the patient developed dyspnœa, which, according to the medical practitioner who saw her, was due to a degree of congestive heart failure.

She responded to treatment and for a while her condition improved. Death took place about six months after operation and, though no autopsy was obtained, was probably due to recurrence.

CASE VI.—A man, aged fifty-two years, who had been ill for a long time, presented himself with carcinoma of the stomach that was so extensive radiologically as to make it probable that a total gastrectomy would be required.

He had been ill for some months and refused treatment. When finally he was persuaded to have treatment the barium meal disclosed a very extensive infiltrating lesion of the stomach. He looked ill, being pale and wasted. His hæmoglobin value was 90% and his plasma proteins were 6·1 grammes per 100 cubic centimetres. He was given one pint of blood and on May 2, 1946, Dr. R. Orton gave him controlled respiration anæsthesia with cyclopropane and oxygen.

The lesion was inspected through a left subcostal incision and on palpation, though obviously very extensive, it was found not to be fixed and was probably removable. The incision was therefore extended dorsally by division of the costal margin and resection of the eighth rib almost back to the angle. The diaphragm was then split down to the hiatus. To remove the mass it was found necessary to remove the spleen and the pancreatic tail and part of the body. The mass was also adherent to the transverse mesocolon, and while this was being freed the blood supply to the transverse colon was obviously damaged, this forcing me to resect part of it. All this took quite a while (about four hours) and the patient started to show signs of circulatory failure. He was given further blood into an arm vein and some digoxin was injected intravenously. His condition improved with this treatment and the operation was continued, but unfortunately at a hurried tempo, and this I fear had bad results, as later he developed signs of trouble at both anastomoses. An œsophago-jejunostomy was done and an end-to-end suture of the transverse colon. The wounds were then closed as usual, that is, the posterior sheath and the diaphragm were closed first, the chest was closed with pericostal steel and wire sutures, and finally the upper chest and abdominal muscles. No drain was passed.

The convalescence was uneventful for about seven days. Then the patient began to suffer from abdominal pain and his abdomen gradually became more distended. After two more days it was obvious that he had an obstruction and that something would have to be done to relieve it. The remembrance of the hurriedly done transverse

colon anastomosis made one think that the most likely site for an obstruction was there, and so with the idea of relieving this a caecostomy was done under local anæsthesia. The result of this operation was disappointing, inasmuch as the caecum was not very full, nor did tapping it relieve the distension. An incision was therefore made on the left side of the abdomen and a dilated coil of small intestine uncovered. This was tapped and a large quantity of gas and intestinal content was drawn off. An enterostomy tube was stitched into the opening and after the distension went down, this was used for feeding purposes, as the patient stated that he swallowed only with difficulty. He had numerous secondary hæmorrhages, for which he received many pints of blood. He now had an enterostomy and a caecostomy, but could and did take food by mouth. This caecostomy, however, remained persistently open, and despite many attempts with enemata and bowel washes, the continuity of his bowel could not be established. He demanded that this be done, but died some two days after it had been carried out. At the operation many adhesions were divided, including the one causing the obstruction of the small intestine.

The lessons learnt from this case were that no matter how grievous the state of the patient at the operation, the making of anastomoses should not be hurried and that the complete removal of the omental buffer removes a great protection and that adhesions are exceedingly likely to occur.

SUMMARY.

The patient with a carcinoma of the œsophagus or the cardiac end of the stomach presents no longer the hopeless problem that he had previously. It may be said that this paper presents no argument to prove this, as of the six patients whose histories are presented, but one is still living. This one, however, presented the most difficult operative problem. The other case of œsophageal carcinoma was probably a hopeless surgical problem from the beginning. The patient, however, elected to take his chances. The experience gained from these two cases would lead me to advise any patient with such a lesion to submit to radical operation. The statement made that œsophageal carcinoma is inoperable before it presents symptoms is not the experience met with in these two cases, as these lesions were readily resectable. However, I believe that all cases of œsophageal obstruction occurring in patients of the cancer age should be diagnosed by active means at the earliest moment and if a positive diagnosis cannot be made immediately, the patient should be subjected to an exploratory thoracotomy. Should a carcinoma be found, it can be resected immediately.

Carcinoma of the cardiac end of the stomach will always present a difficult problem, as its situation, with consequent lack of mechanical interference with alimentary function, will be responsible for an advanced state of growth before the production of symptoms. Again, unless the radiologist has the possibility of the lesion in mind and looks for it, he may quite easily overlook it. However, when once the diagnosis is made, an exploration is justified, as the lesion may be removable.

The mortality, immediate and late, is high. It will be high, as the mortality of any new procedure designed to help very sick people is always high until, with increasing experience, surgeons make fewer mistakes. This is no justification, however, for failing to make the attempt. Without operation the disease is fatal and we now have a way out. The way is hard, but it is possible and should be undertaken.

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A METHOD FOR THE TREATMENT OF FRACTURES OF THE EXPANDED ENDS OF LONG BONES.[1]

By H. K. CHRISTIE,
New Zealand.

THE method of treatment outlined in this paper is a logical expansion of certain well-known orthopædic manœuvres.

The first of these was devised by Böhler,[(1)] of Vienna, who used a heavy clamp or "*redresseur*" to approximate displaced bone fragments. Being applied to the skin surface, his clamping process could not long be maintained without ischæmic necrosis of this highly vulnerable tissue.

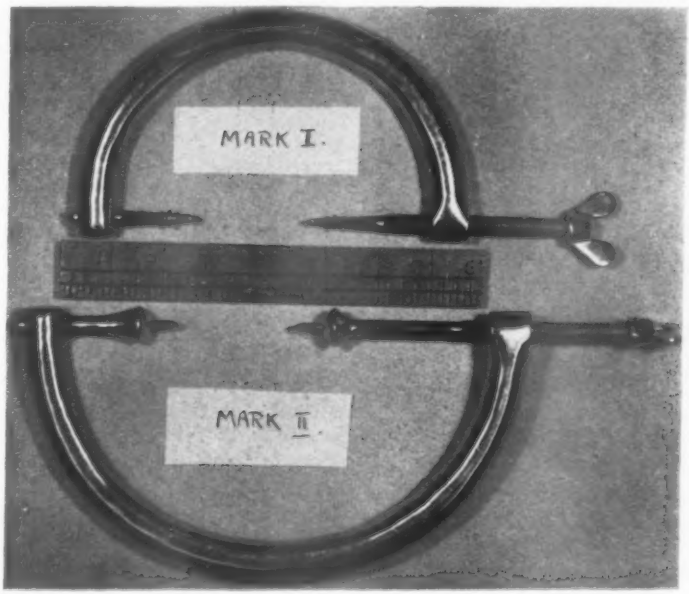

FIGURE I. The clamp. Mark I and Mark 2.

The second procedure was the use of a metallic pin, first introduced into England by Hey Groves,[(2)] but commonly known as a Steinmann pin, to transfix the cancellous bone. Although at first viewed with mistrust, this is now a well-established procedure, and a Steinmann pin through the tibia may remain *in situ* for several months without serious risk of sepsis.

The clamp devised by the writer is a logical development of the ideas of Böhler and Steinmann. The pressure of the clamp is taken by bone instead of skin, while the points penetrate the bone but do not transfix it.

[1] Read at the annual meeting of the New Zealand section of the Royal Australasian College of Surgeons, Wellington, on August 30, 1946. Accepted for publication on December 30, 1946.

FIGURE II. Case I. The fracture before treatment.

Fractures through the expanded ends of the long bones present certain special problems.

1. The bone, especially in elderly people, is soft and spongy, and in consequence is not securely held with screws or nails.

2. The fracture line often communicates with the joint.

3. There is often wide separation of the bone fragments, or one fragment may be grossly displaced.

REQUIREMENTS OF APPARATUS.

To be regarded as effective an apparatus must be able to be used with the following objectives:

1. To reduce and hold reduced the spongy bone fragments around the large joints, such as the knee and ankle.

2. To clamp together and close the wide clefts associated with the oblique fractures of femur and tibia at the knee.

3. To restore the articular plateau in the case of the upper end of the tibia, or to control splaying at the ankle joint.

4. Above all, to permit immediate movements at the affected joint to be carried out without danger of redisplacement.

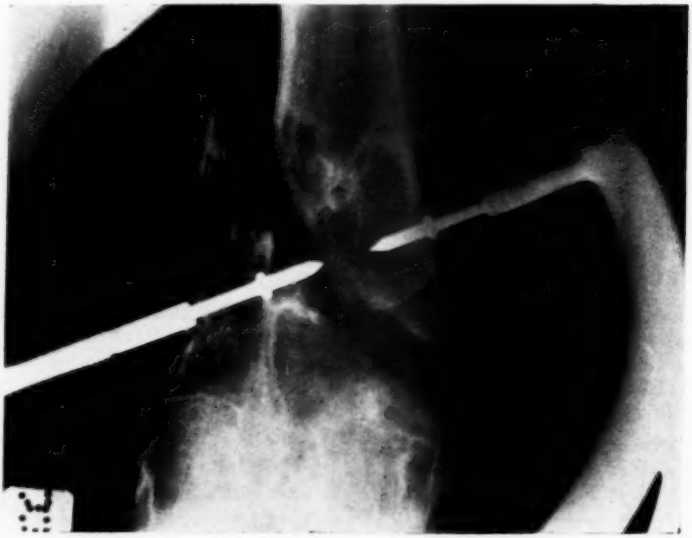

FIGURE III. Case I. Application of clamp (Mark 1).

FIGURE IV. Case I. Result after union of fracture.

POSSIBLE LINES OF TREATMENT IN THESE FRACTURES.

In these fractures the following lines of treatment are possible:

1. Manipulation, including the use of wrench or *redresseur*. These instruments

FIGURE V. Case II. The fracture before treatment.

reduce but do not maintain reduction. If their use is augmented by external fixation in plaster of Paris, the penalty is wasting and stiffness.

2. Open operation and internal fixation with screw and nail.[(1)(2)] An operation is a confession of failure, and since the soft

FIGURE VI. Case II. Application of clamp (Mark 2).

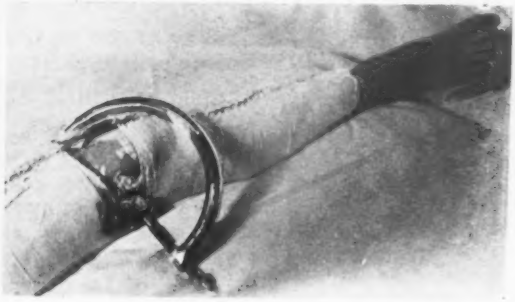

FIGURE VII. Case II. Appearance immediately after application of clamp and a removable plaster.

FIGURE VIII. Case II. The patient ten weeks after clamping, standing erect.

FIGURE IX. Case II. The patient ten weeks after clamping, sitting on heels.

cancellous bone is not safely held with a screw, external fixation must again be used with its penalties (Case VI).

FIGURE X. Case III. The fracture before treatment.

3. The use of a self-retaining clamp, engaging the bone direct and dispensing with other external fixation (Cases I to V).

THE CLAMP.

The clamp is illustrated in Figures I and II. Note that the two pointed jaws of the instrument are held rigidly in sockets. One end carries a threaded shank with wings, by the turning of which the clamp is tightened up.

The "shoulders" of the jaws are rounded and expanded so that they

FIGURE XI. Case III. Application of clamp (Mark 2).

will adapt themselves to any bone contour and will not sink into the cancellous bone.

METHOD OF USE.

Radioscopic control is maintained during use of the clamp. Reduction is carried out with traction *et cetera,* and the skin points are marked for the

FIGURE XII. Case III. Range of movement at three weeks (superimposed exposures).

FIGURE XIII. Case III. Range of movement at sixteen weeks (after one month on full work).

clamp. Short incisions are made at these points. The clamp is applied, put into its final position and tightened up.

FIGURE XIV. Case IV. The fracture of the tibia (the external tuberosity and the anterior tubercle).

FIGURE XV. Case IV. Reduction by means of the clamp.

Reduction with traction is often most easily made by temporary use of a Kirschner wire and stirrup, to which weights are attached. This is especially useful if no assistance is to hand. The expanded points of the clamp are introduced through the short skin incisions and the skin is sutured round

the narrowed portions. The final adjustment and tightening are made under the screen. The principle is that of the carpenter's clamp, which holds

FIGURE XVI. Case IV. The result after six months.

FIGURE XVII. Case IV. The result illustrated.

together two boards whilst the glue is setting. Much less glue is thereby required and a firmer join results. Because the skin will not tolerate pressure, the pressure must be applied directly to the bone and not to the skin.

FIGURE XVIII. Case VI. Fracture of the external tuberosity of tibia and head of fibula. Good operative replacement and fixation with vitallium screw. No early movements. Much wasting and periarticular adhesions. Two manipulations. A final range of movement of only 90°.

Once the bone fragments are firmly clamped together, no further splintage is required, and the surgeon may with full confidence initiate forthwith treatment by active (assisted) movements to the joint. The final range of movement depends on the fact that the joint need not be immobilized for a single day.

It should be noted that correct bone apposition must be secured at the first sitting. A later attempt to apply the clamp along the same track is to be deprecated as possibly introducing infection. With the help of the X-ray screen and a little practice, however, the procedure becomes a certainty.

When clamping is completed a dressing is applied, consisting either of *Tinctura Benzoini Composita* (friar's balsam) or of a light dusting with sulphathiazole crystals and a collodion seal.

The clamp is left in position for periods up to three or six weeks, according to the age of the patient and the type of fracture. The appearance of a little superficial purulent discharge need not occasion its removal. X-ray control is helpful in deciding when it may safely be removed; and reference to

TABLE I.

Number.	Name.	Sex.	Age in Years.	Fracture.	Duration of Clamping.	External Fixation.	Movements Commenced.	Weight-Bearing Commenced.	Results.[1]
I	P.K.	M.	69	Refracture of femur, oblique. (April 28, 1945, to August 6, 1945.)	7 days.	Thomas splint 10 weeks.	3 weeks.	14 weeks.	A senile patient with a preexisting osteo-arthritic knee and an old fracture, re-fractured. Clamping only partially successful, as Mark I clamp too small on shoulder. This case illustrates closure of wide gap by clamping.
II	M.H.	F.	14	Femur, fracture combined with separation of epiphysis. (March 4, 1946, to May 4, 1946.)	23 days.	Plaster gutter 21 days.	24 hours.	7 weeks.	A young patient with rapid bone formation. Full weight bearing in eight weeks. Movement at 4 weeks = 90°. Movement at 10 weeks = 140°. Movement at 16 weeks = full range.
III	J.C.	M.	65	Tibia, internal tuberosity into knee joint. (October 26, 1945, to December 15, 1945.)	5 weeks.	Plaster gutter 10 days.	24 hours.	8 weeks.	An elderly man in fit condition. Driving his own motor car in nine weeks. Full work in 12 weeks. Movement at 24 hours = 30°. Movement at 3 weeks = 90°. Movement at 16 weeks = full range.
IV	H.H.	F.	58	Tibia, external tuberosity (comminuted) and anterior tubercle. (July 27, 1945, to October 12, 1945.)	6 weeks.	Plaster gutter 14 days.	24 hours.	10 weeks.	A middle-aged woman, short and stout. Movement at 24 hours = 30°. Movement at 3 weeks = 90°. Movement at 6 months = full range.
V	A.M.	F.	66	Tibia, external tuberosity, with marked downward displacement and fissuring of the tibia. (April 22, 1946, to August 1, 1946.)	5 weeks.	None.	24 hours.	10 weeks (using a knee-cage).	A senile, heavy type of female. Movement at 24 hours = 30°. Movement at 6 weeks = 80°. Movement at 10 weeks = 110°. Still under treatment. Owing to much fissuring of tibia, a knee-cage was used (from tenth to sixteenth week). December 19, 1946: Full range.
VI	D.G.L.	M.	23	Tibia, external tuberosity, fibula through head. (July 31, 1945, to April 30, 1946.)	Open operation.	Plaster of Paris.	No early movement.	Unknown.	R.N.Z.A.F. pilot:. July 31, 1945 Open operation—reduction and vitallium screw. March 1, 1946: Anæsthetic and manipulation of right knee. April 25, 1946: Anæsthetic and manipulation of knee. July 1, 1946: Quadriceps, one inch wasting; Knee, one inch swelling. Flexion to 90° only. Walks with slight limp. After three anæsthetics this result compares unfavourably with those treated by clamp and early movements.

[1] In Cases I to IV there is no measurable wasting of the quadriceps muscle. In Case V there is half an inch of wasting.

Table I shows that the close apposition obtained by clamping the fragments does in fact reduce the period required for bone repair.

Use at the Ankle.

The standard treatment of fractures at the ankle differs from that adopted for knee fractures, inasmuch as surgeons usually permit patients with ankle fractures to walk early in plaster casing. Even here, however, the clamp has an advantage in that it can be left on during the application and setting of the plaster, and may then be withdrawn through it.

ILLUSTRATIVE CASES.

Six cases are shown in Table I. In Cases I to V treatment was carried out with the clamping method, and Case VI is a fairly representative case of operative reduction which is included for comparison.

These cases include most of the fracture types occurring around the knee joint, and their problems are illustrated by the accompanying photographs.

SUMMARY.

A simple clamping appliance for treatment of fractures of the expanded ends of long bones is described.

Cases illustrating its use in fractures above and below the knee are described.

The outstanding advantage of the appliance is close coaptation of the fragments and such firm retention that movements at the joint can be commenced at once.

Radioscopic control is required during use of the apparatus.

REFERENCES.

(1) Lorenz Böhler: "The Treatment of Fractures", 1936; translated by E. W. Hey Groves.

(2) E. W. Hey Groves: "Direct Skeletal Traction in the Treatment of Fractures", *The British Journal of Surgery*, Volume xvi, July, 1928, page 149. See also *The Journal of Bone and Joint Surgery*, Volume xxvii, April, 1945, page 340: obituary notice and appreciation of the pioneering work of Hey Groves. See also "The Modern Treatment of Fractures", 1916, by E. W. Hey Groves.

(3) Ivar Palmer: "Compression Fractures of the Lateral Tibial Condyle and their Treatment" (operative methods), *The Journal of Bone and Joint Surgery*, Volume xxi, July, 1939, page 674.

(4) Guy W. Leadbetter: "Fractures of the Tibial Plateau" (operative), *The Journal of Bone and Joint Surgery*, Volume xxii, July, 1940, page 559.

THE SURGICAL TECHNIQUE OF THE OPERATION OF LABYRINTHINE FENESTRATION FOR OTOSCLEROTIC DEAFNESS.[1]

By D. G. CARRUTHERS,
Sydney.

THE only practicable way to demonstrate the various points of technique of the labyrinthine fenestration operation for otosclerotic deafness is on the cadaver, and I can assure all that the only way to master the technique and to obtain confidence before operating on the live subject is to perform the operation over and over again on the cadaver.[2] I dare say that most surgeons, after experimenting with the process in this manner, would welcome the opportunity to stand by and see how it goes forward in the live patient. From the demonstrator's point of view, unless he has reached the stage at which the organization of all preliminary preparation and operating theatre routine has been simplified and systematized, so that time is most economically employed, the delays caused while he stands aside to let one or more observers from time to time inspect the field under magnification can scarcely be afforded, and of course such delays also must add to the burden of the patient. There is undoubtedly also an additional risk of droplet infection of the wound should a visitor be a carrier. Precautions can be taken in this regard, but here again preliminary organization must be carefully worked out if one is to be teacher and operator as well. I feel that the method of learning to perform this operation must be as follows. Firstly, careful reading with the study of anatomical illustrations and dry bony specimens is necessary. Next, dissection of many fresh cadaver specimens is needed as well as, during the course of routine operative work, to envisage the performance of various stages of the procedure as it may be applicable to the fenestration operation. It is practicable, especially in performing a modified radical mastoid operation, to proceed as if preparing the tympano-meatal flap of Lempert.

Having progressed through these stages of preparation, the surgeon may with profit watch the actual performance of the operation on a live subject and be able to learn with a minimum of distraction of the operator.

My plan today is not to discuss the whole thesis of a surgical treatment of otosclerosis, but to consider only the surgical technique. To this end I have two or three patients upon whom I have operated, and I have prepared a number of cadaver dissections to show various phases of the operation. I have instruments, including engine-driven burrs of various types, and I shall endeavour to discuss what each will do. I have learned by trial what magnification is essential, and I have had to consider numerous problems of

[1] Read at the annual meeting of the Royal Australasian College of Surgeons on June 11, 1946. Accepted for publication on September 4, 1946.

[2] *Preparation of Cadaver Specimens for Dissection.*—In the post-mortem room, by turning the aural pinna forward and after the calvarium has been removed for examination of the cranial cavity, it is a comparatively simple matter to remove the whole temporal bone without disfiguring the corpse. The specimen is fixed for about one week in the standard formol-saline solution. Surplus portions of the squamosa and superficial soft tissue may be trimmed off and the whole specimen is then firmly set into a plaster of Paris cast in a small box so that it is rigidly held as in the natural position. After it sets, the plaster of Paris block can be held in a small vice so that chiselling, gouging, drilling *et cetera* can be employed. Best of all, the specimen may be kept until the operator is ready to work at leisure and in some place where equipment may be set up as would be possible in the operating theatre.

sterilization and prophylaxis against infection; these too I shall discuss. I shall not attempt to describe the mode of testing and selecting patients for operation. Lempert[1][2] and others[3] have outlined the lessons of experience in this regard. It is unnecessary for me to do more than refer you to the recent literature on these points. Nor shall I at this stage attempt to assess the ultimate worth of this form of operation, except to state that I am convinced that there will yet be further refinements of technique.

FIGURE I. Photograph of cadaver specimen mounted in a plaster of Paris block. In this particular specimen mastoido-atticotomy has been completed, the integumentary lining of the external auditory canal has been uncovered by removal of the bony postero-superior, superior and antero-superior canal walls. The incus has been removed, the head of the malleus has been snipped off and the external and the superior semicircular canals have been exposed.

On the technical side there are numerous points about which I may perhaps offer some useful information.

Anæsthesia.

In my hands local anæsthesia has been highly satisfactory. The patients are of course adequately premedicated. I have found that "Omnopon", one-third of a grain, with scopolamine, $^1/_{150}$ grain, given two and a half hours before operation, and a second injection using "Omnopon", one-sixth of a grain, and scopolamine, $^1/_{300}$ grain, half an hour before operation, provide satisfactory sedation. When the operation has been long and restlessness was evident, a further injection has been given. The patients have told me afterwards that mallet and chisel work was rather alarming, and that vertigo at the time of opening the labyrinth was pronounced. Pain, I think, one has been able to avoid.

I am indebted to C. E. Corlette[4] for a scientifically planned scheme of infiltration and block anæsthesia which renders the area of incision, the external auditory canal, and the mastoid cells and middle ear insensitive and bloodless. Briefly the method is as follows.

1. Through a weal of dermal injection just below and anterior to the mastoid tip the needle is passed nearly vertically upwards until its point touches the rough bone just anterior to the mastoid process and about 1·0 centimetre above its tip. As soon as this point is found a cork marker on the shaft of the needle is adjusted to a place 1·0 centimetre from the skin

surface. Now the needle is just disengaged from contact with the bone and by elevation of the butt end its angle with the surface of the neck is gradually changed so that the needle points upwards, medially and slightly backwards. During this manœuvre, by a process of gently pushing in to the bone and again withdrawing the needle a millimetre or so, each time gradually increasing the inward direction, a point is found at which the needle no longer strikes bone, but rides free. A study of the bony skull reveals that the needle has now passed over a projecting ridge of bone just behind the styloid process and just lateral to the stylo-mastoid foramen. The marker on the needle is now almost touching the skin surface. This depth should not be exceeded. The slow injection of 5·0 cubic centimetres of a 1% solution of "Novocain" with a 1 in 75,000 adrenaline solution at and about this point will cause anæsthesia of the auricular branch of the vagus and ischæmia of the stylo-mastoid, occipital and posterior auricular arteries.

2. The needle is inserted immediately behind the mastoid process, directed from above downwards beneath the deep fascia and close to the bone. Five cubic centimetres of solution dispersed hereabouts will block the lesser occipital nerve, and again the occipital artery and its mastoid branch.

3. Injections are given beneath the skin of the auditory meatus and canal from a point behind the pinna and just anterior to the base of the mastoid, and at the meatus itself superiorly and anteriorly.

4. Infiltration of the skin and underlying tissues down to the bone of the space between the *crus helicis* and the tragus is carried out.

5. An encirclement of an area about one inch wide all around the attachment of the pinna with a wall of 0·5% "Novocain" and a 1 in 75,000 adrenaline solution is effected.

6. When the mastoid antrum is opened a few drops of 20% solution of cocaine with equal parts of adrenaline, 1 in 1,000 solution, may be dropped into the antrum and later a few drops more may be instilled into the middle ear.

Under general anæsthesia there is at times a greater tendency to bleeding, which may delay the operation. There is no reason, however, why the tissues should not first be infiltrated with a 1 in 75,000 solution of adrenaline exactly as one would if using local anæsthesia. I think this preliminary infiltration is indicated when the endaural incision is used, for hæmorrhage here may otherwise obscure the very clear field which is necessary for this approach.

THE INCISION.

Lempert's endaural incision[1] is wholly adequate for the operation. It is remarkable how it opens out, giving quite wide access to the mastoid process, attic and middle ear and to the zygomatic root and anterior meatal wall. It heals with very little scarring and with but little tendency to contracture. To try this incision in a radical or modified radical mastoidectomy is perhaps the only way to secure personal confidence in its effectiveness. I have performed mastoid-atticotomy and labyrinthotomy through the mastoid incision, however, and have found it to give access almost equally as good as the endaural approach, provided the incision is extended forwards far enough at the upper end. With the posterior approach it is wise too to make an incision through into the external meatus to delineate the outer end of the epidermal flap and to avoid tension on it by retractors, which may cause it to be torn from its much more delicate inner end where it passes into the tympanic membrane.

POINTS IN THE BONY DISSECTION.

The mastoid antrum is approached by the usual methods employed in the performance of mastoidectomy. The outer wall of the additus and attic are then taken down by fine chiselling, gouging, curettage or engine-driven burr. This is tedious work, but should be done, as Lempert advises,[1] by a process of gradually thinning the bone down closer and closer to the auditory canal until only a very thin bony layer remains, and this is then carefully lifted away in fragments from the underlying integument. This process is most difficult in the region of the antero-superior section of the canal wall, for here the angle of access is difficult and the bone is dense. It is a point, however, where greatest pains are required to effect a separation without tearing, for there seems to be a prolongation of the periosteum of the auditory canal through the petro-tympanic fissure for a considerable distance along the anterior meatal wall.

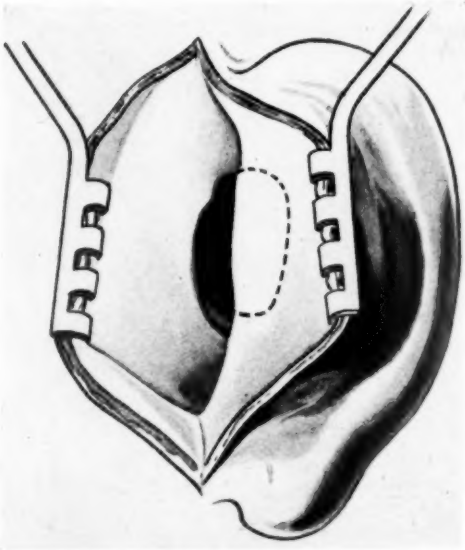

FIGURE II. Drawing to illustrate incision which should be made through the outer section of the posterior meatal integument in order to avoid deeper tearing should the surgeon prefer that the approach be made through the standard mastoid incision.

In the region of the deeper portion of the external auditory canal, adjacent to the tympanic annulus, a layer of thick bone dips downwards and inwards so that here a little further thinning has to be done in order to chip off the annulus itself. I find that with very great care and the use of fine instruments it is possible usually to strip the membrane from the posterior portion of the annulus, and then there remains quite a wedge of bone forming the posterior portion of the annulus and overlying quite a recess of the middle ear. The facial nerve appears to be deep to the base of this wedge, but I suspect that the *chorda tympani* nerve actually lies in it or closely upon its deep surface. From cadaver study it seems that this bony wedge should be largely removed in order that the flap may lie smoothly, yet I feel that this is a segment of bone prone to obstinate necrosis, as many may have observed, in chronic middle ear and mastoid infections. Perhaps the answer is in complete removal of the bony wedge down to a smooth base. The risks to the facial nerve and to the plastic flap are obviously greater if this is attempted, however.

There is a somewhat similar bony wedge supporting the anterior portion of the annulus. I find that one can detach the membrane fairly readily here too, but the bony wedge is extremely hard to deal with and a slip of the instruments, especially if one is foolish enough to use a burr here, is very likely to rip right into the flap and ruin it.

After separation from its bony frame the meatal integument is best left uncut at this stage, until one is ready to shape and to use the flap for which it is reserved.

Separation and removal of the incus are readily carried out, but should be done with care, as cadaver specimens have at times shown a loosening of the stapes footplate.

Resection of the head of the malleus should be made as close to the short process as practicable. I have found a little pair of ophthalmic scissors (Figure III), having rather strong rigid blades, thoroughly satisfactory for this. The blades are passed in around the malleus neck until their blunt inner ends find a supporting point on the opposite tympanic wall. This latter fixation point prevents a certain amount of lateral movement and lessens the risk of tears. The malleus is seen to rotate a little as the scissor blades grip it. This rotation movement is allowed for and corrected by an appropriate counter-movement of the scissors. As the tympanic membrane has been freed from most of its peripheral attachment by the previous dissection, there is some mobilization of the tympanic membrane; this further

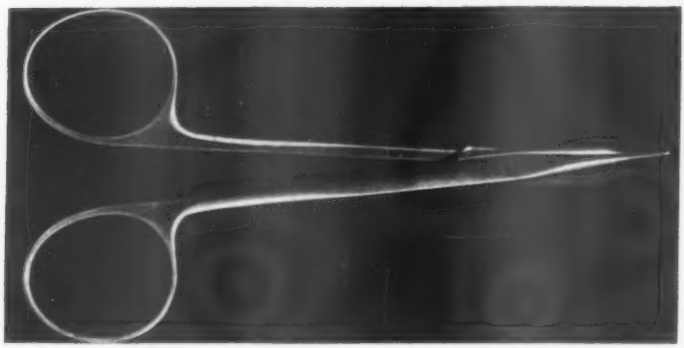

FIGURE III. Type of scissors used to snip off head of malleus.

lessens the risk of tearing which might result from a flick of the malleus handle as its neck is severed. The actual decapitation of the malleus is performed quite easily as the little scissors are carefully closed.

The external meatal flap itself is not by any means in every instance the delicate membrane which Lempert describes. Although its inner portion is as a rule rather delicate, its outer section, often extending to within half an inch of the annulus, is occupied by a plaque of cartilage of variable thickness, which is well nigh impossible to dissect out, but which may have to be cut off, as the curved shape of the auditory meatus prevents close application of the remainder of the flap to the fenestra and adjacent bony area. In many instances I have found that the deeper sections of the flap too were of fairly thick proportion owing to a fibrous layer associated with the periosteum. Lempert made much in his original report of a claim that he caused Shrapnell's membrane to cover the fenestra which he then used to make at the prominence of the external semicircular canal. It is quite impossible by any process of stretching or manipulation to cause Shrapnell's membrane to reach so far as the arch of the external semicircular canal. One of the principal claims in favour of Lempert's later devised *fenestra novo-ovalis* was that, after removal of the incus and the head of the malleus, Shrapnell's membrane could more often be brought to overlie the fenestra. I still do not think it can be done at all. The tiny thin segment which comprises Shrapnell's membrane does not reach across to the site of the fenestration, so that the covering provided by this flap is periosteum and epidermis and is not a very thin membrane covered on either aspect by epithelium.

THE SITE OF FENESTRATION.

Confusion and frustration will be the lot of those who try, in vain as they will, to make an opening of 5·0 by 2·0 millimetres, let alone one of small

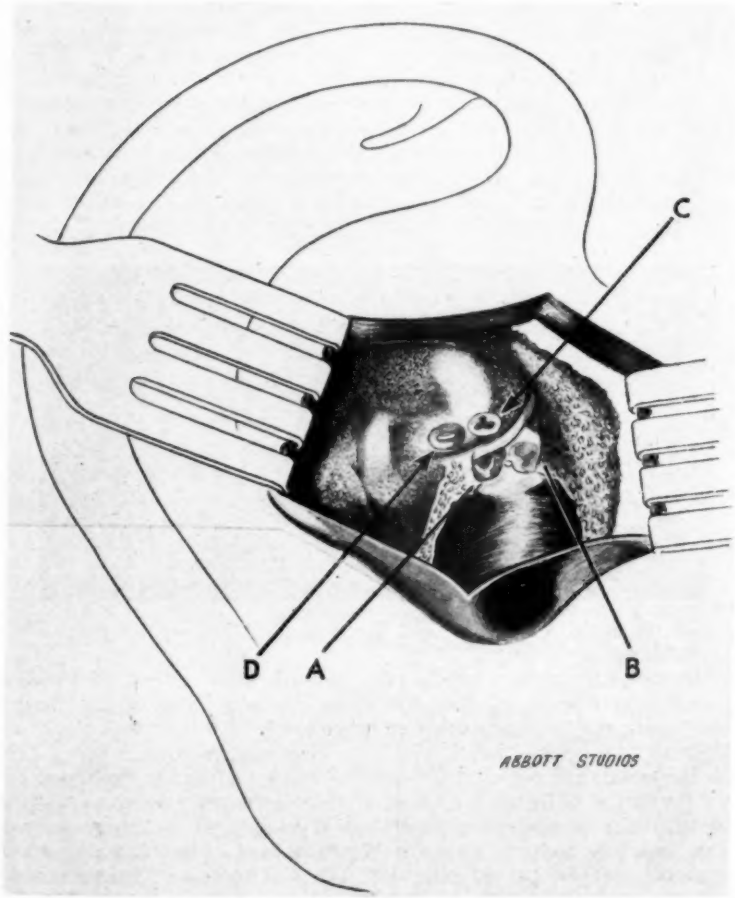

FIGURE IV. Drawing to illustrate the approach to labyrinthine fenestration. The bony posterior, postero-superior, superior and antero-superior sections of the wall of the external auditory canal have been removed, the integumentary lining being left intact and continuous with the tympanic membrane. The incus and the head of the malleus have been removed, the vestibular end of the external and superior semicircular canals, the facial nerve and the stapes being exposed. It can be seen that there are remaining projecting wedge-like buttresses of bone supporting the tympanic annulus posteriorly (A) and to a less extent anteriorly (B). To complete the process of exposure of the integumentary lining of the external canal and to enable the flap ultimately to be turned upwards so as to lie over the semicircular canals, these bony buttresses need to be removed. Also in this illustration the form of triradiate opening obtained when one attempts to fenestrate the so-called dome of the vestibule is shown at C. The appearance of a fenestra made into the arch of the external semicircular canal is shown at D. An opening which compromises between these two appears to be the site of choice.

dimensions, into the surgical dome of the vestibule, as Lempert names it. There is a small area of approximately these dimensions just behind the locus of the geniculate ganglion. On proceeding directly inwards to attempt

to drill this area, one finds just solid bone or occasionally cellular bone. Working downwards, one still finds solid bone after proceeding, as far and as bravely as one of any reason should dare, behind and deep to the facial nerve. One next tries to make the opening a little further back, and here, after careful drilling to a depth of about 1·0 millimetre, the shadow of a cavity begins to show. A little further careful thinning of the bone reveals this to be the ampullary end of the external semicircular canal. At this location too there is soon evident an additional little dark shadow just above and anterior to the former one, and this soon is found to be the ampulla of the superior semicircular canal. With bold courage and perseverance a very tiny segment of the superior wall of the vestibule can now be thrown open in common with the ends of the two semicircular canals. The resultant fenestra in its depths is neither oval nor round, but rather like a three-petalled flower. To attempt to convert it into a rounded funnel must cause damage or destruction of the expanded ampullæ of the membranous semicircular canals. In the illustrations of his recent paper in which he describes the use of a cartilaginous stopple in the fenestra, Lempert[5] still speaks of making the *fenestra novo-ovalis* into the surgical dome of the vestibule, but his illustrations are distinctly of an opening into the anterior end of the external semicircular canal. One notes the point because to anyone attempting the dissection and endeavouring to make the wide round opening shown in the pictures in Lempert's paper first describing the *fenestra novo-ovalis,* the problem is most confusing.

The cartilage graft or stopple to be fitted into the fenestra may usually be fashioned from the already conical ovoid of the *spina helicis,* lying just adjacent to the upper end of the skin incision. In several cases, however, I have found the *spina helicis* and other portions of the aural cartilage, especially in females, to be small and flat rather than ovoid on section. One must be prepared in these instances to cut down quickly onto the cartilaginous rib junction for an adequate graft. The placement of the flap, toilet and wound dressings call for no special comment.

CONVALESCENCE.

Post-operative vertigo has not caused severe disturbance in any of my cases. Every patient has noticed the symptoms, and especially on turning the head, but as a rule after four or five days equilibrium is reestablished and except for some momentary giddiness when the ear is mopped out, no disturbance of this function has been observed. Hearing has frequently shown a sharp drop-off on about the third or fourth day, and during convalescence has often varied from day to day until the cavity has become dry and finally healed, when there is usually a little further gain in acuity.

The healing process has been far from free of anxiety. The cavity takes quite a while to become completely healed and discharges a mucoid exudate for six to eight weeks. In all cases this exudate has been a little purulent, but never such as to suggest an acute infection of the cavity. In three instances acute *otitis media* occurred at about the twelfth post-operative day. It has never given the impression of being a very intense inflammation or virulent infection, but it has persisted for three to eight weeks and has caused me to wonder whether it is caused by the cartilage graft, although the absence of labyrinthine suppuration might point against this. Penicillin and sulphonamides both given parenterally and applied locally have seemed to restrain the inflammatory process, but have never caused any speedy drying up of the middle ear, which has seemed just to take its own time to get well, as if it was a matter of throwing something off and of course becoming covered with epithelium.

I would make this warning to all who may undertake this form of aural surgery. The operator must be prepared, for at least four weeks, to do daily dressings himself. The wound is likely to be readily infected. I believe that the ear, nose and throat surgeon, handling many septic cases every day, is likely himself to be a carrier unless deliberate precautions are taken. This means thorough surgical washing, the wearing of sterilized gloves, and heavy nose and mouth masking for every dressing. Penicillin and sulphanilamide powders are used very lightly to cover the raw surfaces each day. Old powder has to be swabbed out with sterile wool and sterile lotions, and the powder insufflator has to be boiled and dried each time it is used.

CASE HISTORIES.

Mrs. W.G.S., aged thirty-nine years, complained of deafness, especially in the right ear, of about twelve years' duration, gradually progressive and associated with troublesome tinnitus. The ears had a healthy appearance. The Eustachian tubes were patent. Rinné's test produced a strongly negative result. She had been using a hearing aid but did not like it and desired operation.

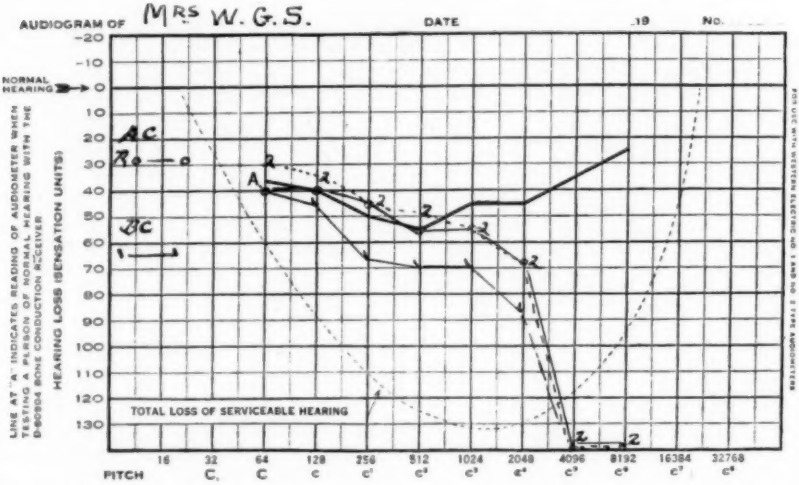

FIGURE V. Audiogram of right ear of Mrs. W.G.S. August 18, 1945, air conduction and bone conduction shown respectively "0—0—0" and "1—1—1". June 11, 1946, right ear air conduction, tympanic perforation open shown "2---2---".

Audiograms revealed a tendency to dropping off of bone conduction hearing, especially above 1,024 cycles. The patient was advised of only a moderate likelihood of benefit. She desired the operation to be tried. Labyrinthine fenstration operation was done on the right ear on February 18, 1946.

After operation she had well-marked vertigo for about four days, but was able to sit up and to eat well. Hearing for conversation seemed to be greatly improved, but would vary.

Packing was removed on the tenth post-operative day. Slight serous otorrhœa continued for about three weeks. During the second week she developed considerable earache, but this rapidly responded to an ichthyol-glycerine dressing and some heat.

During the third week the tympanic membrane was seen to have ruptured through a pinhead perforation in the postero-inferior quadrant. The patient was treated with penicillin ear drops. Early in the fourth week she had severe ear and mastoid aching and developed mastoid tenderness. This subsided after the administration of 500,000 units of penicillin and ichthyol-glycerine dressings, but the tympanic perforation became larger and extended back towards the annulus, and at this point a little red granulation could be seen. Careful treatment with silver nitrate has eliminated the granulation

tissue and the discharge has now almost ceased, but a large perforation remains. Objectively the patient's hearing appears considerably better than before operation. The audiogram is seen in Figure V.

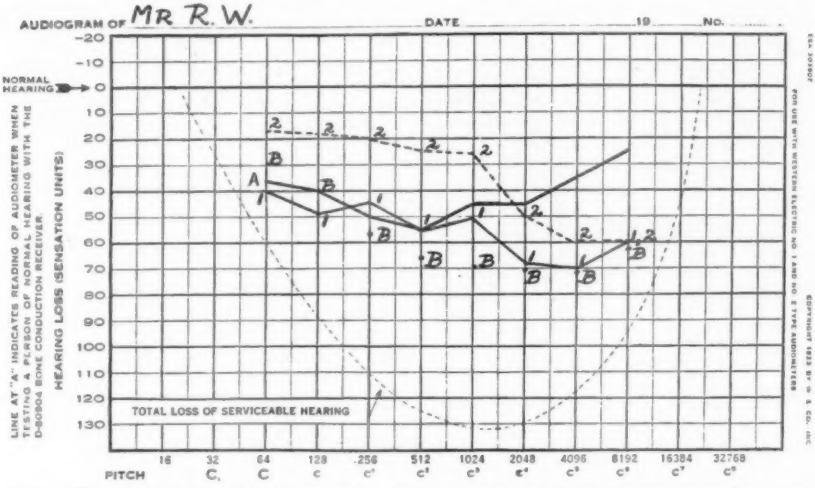
AUDIOGRAM OF MR R.W.
DATE
19
No.
NORMAL HEARING
HEARING LOSS (SENSATION UNITS)
LINE AT "A" INDICATES READING OF AUDIOMETER WHEN TESTING A PERSON OF NORMAL HEARING WITH THE D-80904 BONE CONDUCTION RECEIVER.
TOTAL LOSS OF SERVICEABLE HEARING
PITCH
16 32 64 128 256 512 1024 2048 4096 8192 16384 32768
C, C c c' c² c³ c⁴ c⁵ c⁶ c⁷ c⁸

FIGURE VI. Audiogram of left ear of Mr. R.W. August 22, 1945, before operation, bone conduction, shown "B.B.B."; air conduction, before operation, shown "1—1—1". October 18, 1945, air conduction, after operation, shown "2--2--2".

Mr. R.W., aged thirty-five years, complained of deafness of gradual onset extending over ten to twelve years. The ears appeared healthy and normal; the Eustachian tubes were freely patent. Bone conduction was much better than air conduction.

The patient was treated for nine months with phosphorus pills and vitamin B_1, and thought his hearing had improved.

Left labyrinthine fenestration operation was performed on September 9, 1945. Vertigo was marked for three or four days when the patient turned. He did not vomit and was able to eat well. Dressings were removed on the tenth post-operative day.

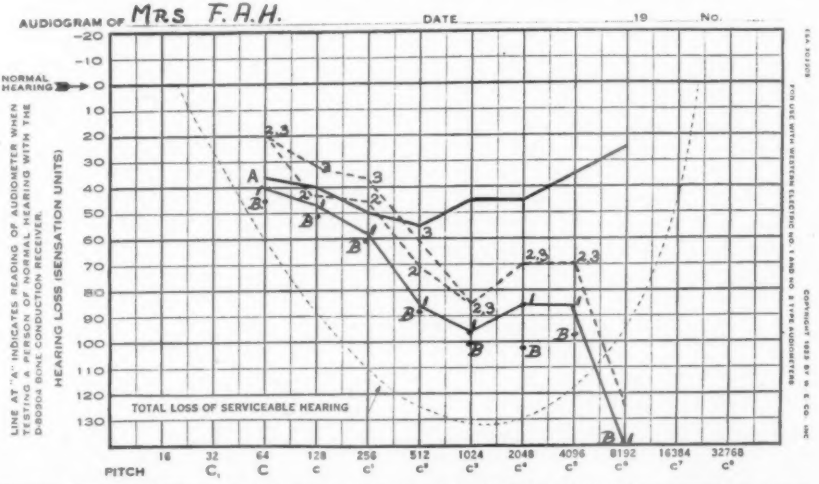
AUDIOGRAM OF MRS F.A.H.
DATE
19
No.
NORMAL HEARING
HEARING LOSS (SENSATION UNITS)
LINE AT "A" INDICATES READING OF AUDIOMETER WHEN TESTING A PERSON OF NORMAL HEARING WITH THE D-80904 BONE CONDUCTION RECEIVER.
TOTAL LOSS OF SERVICEABLE HEARING
PITCH
16 32 64 128 256 512 1024 2048 4096 8192 16384 32768
C, C c c' c² c³ c⁴ c⁵ c⁶ c⁷ c⁸

FIGURE VII. Audiogram of left ear of Mrs. F.A.H. July 26, 1945, before operation, bone conduction, shown "B.B.B."; air conduction, before operation, shown "1—1—1"; March 21, 1946, air conduction, after operation, shown "2--2--2"; December 7, 1946, air conduction, after operation, shown "3--3--3".

Slight serous otorrhœa continued for about five weeks and then the discharge became muco-purulent, but without signs of inflammation and without vertigo or loss of hearing. Treatment with penicillin drops, 500 units per cubic centimetre, was followed by rapid drying up and complete healing of the cavity.

In March, 1946, the patient thought hearing had deteriorated. (See audiogram, Figure VI.)

Mrs. F.A.H., aged thirty years, had complained of deafness for about ten years. One brother was hard of hearing; no other relatives were deaf. The ears appeared healthy, but there was a suspicion of a scar of an old perforation in the right ear. The Eustachian tubes were patent. The Rinné test gave a strong negative response in both ears.

The patient was advised to try a hearing aid, as bone conduction response was not quite good enough. She desired to have the fenestration operation, as she did not want to wear a hearing aid.

A left labyrinthine fenestration operation was done on November 11, 1945. Hearing seemed greatly improved for three to four days, in spite of the dressing being *in situ*. Marked vertigo was present for twenty-four hours, then only on turning for a further three to four days. All vertigo ceased on the eighth post-operative day and the hearing seemed to have faded compared with the first three days.

The packing was removed on the tenth post-operative day. There was considerable serous discharge from the ear after the first dressing, but this rapidly became less. The grafted area and tympanic membrane appeared to be completely healed and of normal texture after the third week. There was a slight serous discharge, at times with a little pus, from granulations around the periphery of the external meatus, and this took about nine or ten weeks to dry up. One week earlier this area again became tender and discharged sero-pus. The hearing, although better than before operation, has not returned to that observed on the first three post-operative days. She has from time to time had some tinnitus. Audiogram is shown in Figure VII.

This patient was advised on account of the marked dropping off of acuity above 256 cycles that she was not a particularly good subject for operation.

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SOME ASPECTS OF THE SURGICAL PATHOLOGY OF THE TESTIS.[1]

By NORMAN WYNDHAM,
Sydney.

TESTICULAR DESCENT.

So many erroneous statements are made concerning the development of the testis that time spent in discussing the main features of the subject would not be wasted. The subject has interested anatomists for many years. Galen knew of the temporary abdominal position of the testis. Vesalius described the *processus vaginalis*. In the eighteenth century Haller, Cowper, Paletta, Vicq d'Azyr and John Hunter (1786) contributed to our knowledge of the subject. In Figure I, taken from a modern textbook, commonest errors concerning testicular descent can be seen. In a recent article by Bishop (1945) the descent of the testis from the region of the kidney is considered a normal event.

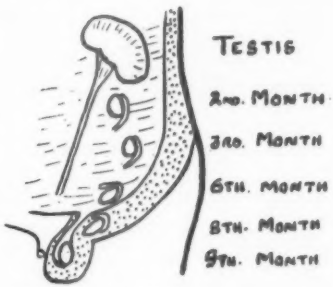

FIGURE I. A diagram to represent stages in testicular descent as given frequently in textbooks.

The facts are these. The testis develops as a proliferation of cœlomic epithelium on the antero-medial aspect of the intermediate cell mass, in its caudal half in particular. The cephalic limit to this proliferation is vague, but is never extensive. That is, the gonad is from the beginning situated low in the abdomen.

At first it lies in the long axis of the body, but its cephalic end is pushed laterally by the growth of the suprarenal gland (which becomes the second largest organ in the abdomen) and by the development of the metanephros. The statement is often made that the testis begins its descent from the position of the kidney. If this means, as it obviously does, the position of the adult kidney, nothing could be further from the truth. Bramann in 1884 pointed out that the testis is never more than 1·0 millimetre from the groin. In eleven specimens whose crown-rump lengths varied from 20·0 millimetres to 56·0 millimetres I found that the maximum distance of the gonad from the groin was 1·8 millimetres. The metanephros, developing from near the junction of the Wolffian duct and urogenital sinus, is at first posterior and caudal to the gonad. It is fixed to the posterior belly wall, so that by the increase in length of the embryo as well as by its own growth it passes relatively in a cephalic direction so that it can be seen from in front, between the gonad and suprarenal gland (Figure II). True, the distance between testis and kidney increases, but not owing to any movement on the part of the testis. The only alteration in position of the latter is the lateral swinging of its cephalic pole.

Lateral to the gonad lies the Wolffian duct. It develops in the antero-lateral part of the intermediate cell mass, the caudal part of which is

[1] Read at the annual State meeting of the Tasmanian Fellows of the Royal Australasian College of Surgeons. Accepted for publication on October 4, 1946.

involved in the tail fold so that the Wolffian duct runs alongside the cloaca. The proximity of the intermediate cell mass to the cloacal membrane in an embryo of 10·0 millimetres can be seen in Figure III. The contiguous walls of the Wolffian duct and cloaca fuse so that the duct enters on the postero-medial aspect. From this point in its development onward the caudal part of the Wolffian duct turns medially, the angle so formed being connected to the groin by a fold of peritoneum, the *plica inguinalis*, which must be assumed to contain remnants of the caudal end of the intermediate cell mass, just as the cephalic remnant of the mesonephros and intermediate cell mass can be found in the fold called by Kölliker (1849) the *Zwerchfellsband der Urniere*.

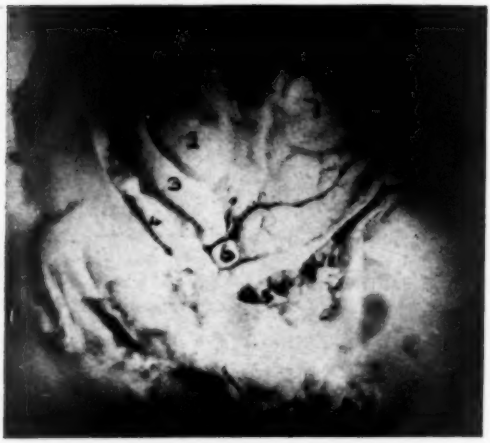

FIGURE II. 1 = suprarenal gland; 2 = kidney; 3 = gonad; 4 = Wolffian and Müllerian ducts; 5 = *plica inguinalis*; as seen in a 22-millimetre embryo (human).

In the *plica inguinalis* develops subsequently the gubernaculum. As Moszkowicz (1935) has emphasized, the undifferentiated precursor of the latter is present in the abdominal wall before the lateral sheet of mesoderm becomes muscularized. There is never any invasion and penetration of the belly wall as described by Berry Hart (1909). Caudally the tissue in the *plica inguinalis* is prolonged round the side of the cloacal membrane to that area where the phallus and pubic regions will develop. Near by is the developing limb bud. The attachment is to an area and not to different points, as described by Lockwood (1888). It is obvious also that the gubernaculum, when it develops, will be attached not to the gonad, but to the Wolffian duct, that is, to the junction of the *vas deferens* and epididymis in the male, and in the female, the Wolffian duct having atrophied, to that part of the Müllerian duct which subsequently forms the uterus. In the male the mesorchium is normally short, but it is long in many varieties of maldevelopment of the testis. Eccles (1903) describes an instance of descent of the epididymis into the scrotum, the testis remaining undescended. In the female the mesovarium is longer and early shows a thickened medial border which becomes the ovarico-uterine fold.

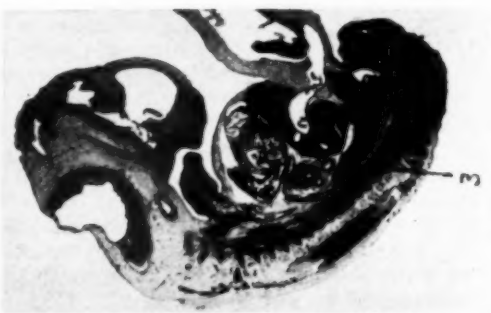

FIGURE III. A 10·0-millimetre human embryo. M is mesonephros.

The *processus vaginalis* appears as a dimple of peritoneum anterior to the gubernaculum somewhere about the tenth week. It can be seen in

Figure IV. There is no histological evidence that its increase in size is due to its own cellular proliferation. Differential growth rates must be an important factor. At this stage it remains small, growing no faster than the rest of the embryo.

When the embryo is about 20·0 centimetres long, striated muscle appears in the tissue contained in the *plica inguinalis*, which I have, for convenience sake, already called the gubernaculum. So active is the growth of this tissue and so vascular does it become that the testis is pushed a little cephalically. Most of the discussion concerning the mechanism of testicular descent centres around this structure, which Van den Broek (1906) and others compare with the *conus inguinalis* of some lower forms. To be honest, one has to admit that we do not know the mechanics of testicular descent. Some fantastic theories have been put forward. One very competent anatomist suggested that the weight of the meconium-filled bowel was a factor, regardless of the inverted position of most infants. The gubernaculum has been said to turn itself inside-out like the finger of a glove (Klaatsch, 1896, Frankl, 1895, *et cetera*). Some picture the testis sliding on the posterior wall of the *processus vaginalis* as on a sledge, the effect of gravity, with the child *in utero*, somehow not causing the testis to move higher in the abdomen. It is hard to imagine how the gubernaculum could pull by muscular contraction, since neither attachment is rigid.

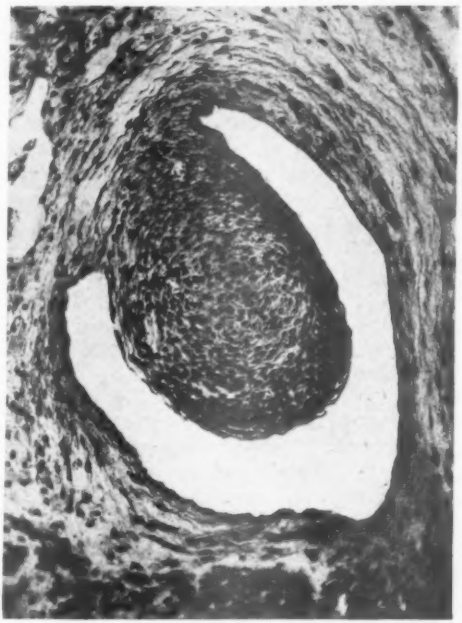

FIGURE IV. Section through *processus vaginalis* and *plica inguinalis*.

Anatomically several points are of interest. In all the specimens that I examined the testis was either in the abdomen or at the bottom of the scrotum. Nor is it easy to find descriptions of more than one or two specimens where the testis has been caught, as it were, in the process of passing between belly cavity and scrotum. This stage can often be seen after birth, but nothing comparable to the bulky gubernaculum of the embryo exists then. Nor is there any need for any "traction". In the specimens examined descent appeared to occur about the end of the seventh month. The absence of intermediate stages in descent seems to suggest that this occurs rapidly. The passage down the inguinal canal is not followed by a rapid closure of the *processus vaginalis*. Two points are of importance. Firstly, there is no evidence of tension on the structures cephalic to the testis. Bell (1826) described how the vessels remained "elegantly tortuous". That is, they lengthen as the testis descends. Secondly, the gubernaculum disappears, apparently being absorbed as the testis approaches the scrotum. One can imagine that shortening of the gubernaculum could pull the testis down, provided the structures attached to the testis cephalically lengthened

accordingly. However, this approaches the realm of speculation. The stimulus to descent comes apparently from the pituitary gland (Engle, 1932), but the medium for the action of the hormone is, in part at least, the testis itself. Hunter (1786) suggested that the testis did not descend because it was abnormal. This is probably so, although a testis denied the relative coolness of the scrotum will not develop properly. This aspect will be considered in more detail when the management of cryptorchidism is under discussion.

THE UNDESCENDED TESTIS.

No satisfactory explanation has so far been given as to why the testis leaves the comparative safety of the abdominal cavity and finds a new home in a new structure, the scrotum. The phenomenon occurs only in mammals, but not in all mammals. Monotremes, most edentates, sirenians, cetaceans and some other carnivores have the testis situated in the abdomen. Rodents and some edentates have testes which are intermittently in the scrotum. The woodchuck, hedgehog and mole have testes in the abdomen during cold months, while those of the gopher and chipmonk come down only on copulation (Deming, 1936).

Testes which remain in the abdomen in animals in which descent is normal do not develop. The same retardation can be achieved by warming the testes. The testes then remain smaller than normal. This is mainly due to imperfect development of the seminiferous tubules. Patchy spermatogenesis may occur for a while after puberty, but this eventually ceases. Moore (1923) and others have not been able to find evidence of spermatogenesis after puberty. Felizet and Branca (1898) found that some undescended testes contained spermatogonia and spermatocytes, but rarely spermatids. Spermatozoa were not seen. Nevertheless there seem to have been undoubted examples of spermatogenesis in such testes. The classical example, of course, was the student in Astley Cooper's class who committed suicide on hearing that bilateral cryptorchids were sterile. Cooper found spermatozoa in each testis *post mortem*. Rea (1939) found that young adults were not necessarily sterile. The tubules are widely separated by increased connective tissue stroma which is well supplied with blood vessels. The epididymis remains normal. In dogs in which the testes have been replaced into the abdomen there is eventually no seminiferous epithlium, only Sertoli cells. Moore in experiments with adult guinea-pigs found that degenerative changes can be seen six days after the testis is replaced in the abdomen. After twenty-four days the seminiferous tubules possess but a single layer of cells with a few spermatogonia. If such a testis is returned to the scrotum, it regains normality in three months. There is some evidence to show (Cooper, 1929) that the further the pre-adolescent testis has descended, the more closely does it compare histologically with the normal one. Apart from spermatogenesis the function of the misplaced testis is normal.

An important and vexed subject is the relationship of imperfect testicular descent to malignant disease. Tumours of the testis are not very common, and growths in undescended testes must of necessity be encountered very rarely. Therefore individual opinions on the subject are valueless. Eccles found no growths in 859 cases of undescended testis. If large numbers of cases are examined it is found that cryptorchidism amongst men with testicular tumours occurs in 10% to 11% of cases, whereas amongst healthy men it occurs in about 0·2%. We do not know how many imperfectly descended testes become malignant. A suggested figure (Rea) is 3·2%. Even when the testis is placed in the scrotum it may later become malignant. It

runs the same risk as the primarily normal testis. Bishop states uncritically that the possibility of malignant change is not reduced by orchidopexy. Gilbert (1941) has reviewed this aspect of the subject. The prognosis in these cases is reported to be bad (Gordon-Taylor, 1938, and Odiorne and Simmons, 1904).

In a series of twenty-five cases of testicular tumours which I examined, most of the patients having been directly or indirectly under my care, five were of interest in their relationship to imperfect descent. In two cases tumours developed in testicles which were in the inguinal canal, and in a third case the tumour was intraabdominal. In two others non-descent existed, but the tumour occurred in the normally situated organ. Similar findings have been recorded by Dean (1935) and Hinman (1933). This is of interest in the light of Gilbert's statement that, in bilateral cryptorchidism, tumour in one testis is followed by tumour in the other in a quarter of the cases. The case of intraabdominal tumour is of interest, although it has been recorded elsewhere.

C.H.B., aged thirty-five years, was operated on by Wing Commander E. M. Fisher in the Third Royal Australian Air Force Hospital for a mobile abdominal tumour. For two years prior to operation he had been investigated intermittently for attacks of severe left-sided abdominal pain closely resembling Dietl's crises. No cause for the pain was ever found. Immediately prior to operation it was found that he had two tumours. One was round and appeared on occasions in the left hypochondrium. At other times it was impalpable. There was also a fixed mass in the left groin. At operation the latter mass proved to be malignant glands. The external iliac and paraaortic glands were also involved. The first tumour was a malignant testicle attached by a long pedicle to the point where the testicle lies in the embryo, namely, just inside the internal inguinal ring. The tumour was a seminoma. Post-operative irradiation was carried out. The patient is still well a year after operation.

Conflicting reports have been given concerning the incidence of cryptorchidism, and especially of the percentage of testes which spontaneously migrate to the scrotum before or during adolescence. The incidence in young adults is about 0·2%. Wangensteen (1927) quotes 0·1% as the incidence given by Marshall. Rea states that the incidence in the Austrian army, according to Ziebert, was 0·2%. There were 3·1 cases of ectopy for every thousand men examined in the American army during the first World War (Rea). Concerning spontaneous cure, Hofstätter (cited by Wangensteen) states that it does not occur, while Drake (1934), who examined eleven cryptorchids between nine and nineteen years of age, found that ten of the testes descended without intervention. His incidence was 4·2% in 260 boys examined. McCutcheon (1922) found that the incidence was 9·8% in boys under fifteen and 0·16% in those over fifteen years of age. The condition was common in the Australian army, being frequently associated with hernia. Such vague statements as the latter are perhaps unwise, but the incidence of 0·2% seems to be acceptable. If in something like 90% of cases of delayed descent spontaneous cure occurs, the initial incidence must be about 2%.

Some practical considerations follow naturally on the above. The ideal position for the testis is the scrotum. There spermatogenesis occurs normally, injuries including torsion are less likely (although this is open to question) and malignant changes are somewhat more likely to occur. The abdominal transplanting of the testis as an operative measure must be condemned, since tumours in such testes are hard to diagnose. They are missed only too often when in the scrotum.

The majority of undescended testes will proceed to the normal scrotal position unaided. Some, especially the bilateral ones, do not. They require assistance. It is outside the scope of this paper to discuss methods of treatment. The anchoring of the testis to the thigh, essential in most cases,

may be prevented by the shortness of the vascular attachments of the testis and by adhesions, whether gubernacular in origin or not. The anatomical problems have been described frequently in the literature, as have the methods of overcoming them—high dissection, medial transportation of the cord *et cetera*. There is no need to interfere with such a testicle before puberty, even in the presence of hernia, unless the treatment of the latter is urgent.

THE HORMONAL RELATIONSHIPS OF VARIOUS TESTICULAR LESIONS.

Full testicular development requires gonadotropic pituitary hormone. The exhibition of this hormone or, better still, the anterior pituitary lobe hormone of pregnancy urine, will cause the descent of the testis in the Macacus monkey (Engle, 1932). Spence and Scowen (1935), following on earlier work by Schapiro, used gonadotropic hormones in boys with cryptorchidism. Since then much work has been done. It is significant that no definite opinion has been reached. On the whole the results appear to be disappointing (Counsellor, 1941). This is not the place to discuss the virtues of endocrine therapy in this condition. Non-descent is mostly unaccompanied by marked evidence of other endocrine disturbance, nor is this necessary as an indication for treatment. The luteinizing, chorionic type of hormone produces descent, affecting the interstitial cells. The improvement in epithelial development is secondary to the changed environment. I have used the hormone of pregnancy urine, but could never be certain that those testes that descended—and many do as the result of this treatment—would not have come down spontaneously. There is no doubt that the treatment has an influence on the size and position of most undescended testicles, and the accompanying histological changes have been clearly described. I have no hesitation in using it as an adjunct to surgery, giving it for some weeks prior to operation. Excessive administration has been followed by abnormal genital growth, prostatic enlargement, premature puberty and damage to seminiferous epithelium (Heckel, 1941). Other deleterious effects have been produced only in the experimental animal. Perhaps, as Bishop says, "it is much better to have a large penis and an adolescent moustache at ten than a small penis and not shave at twenty".

FIGURE V.

It is assumed that all testicular hormones are elaborated by the interstitial cells described by Leydig (1850). Certainly it is established that these cells do elaborate androgens as do tumours of these cells (Rowlands and Nicholson, 1929, Stewart *et alii*, 1936). Nation *et alii* (1944) state that all children with these rare tumours have endocrine disturbances of androgenic type and that gynæcomastia occurs in 15% of cases. Further, it has been shown that testosterone propionate causes development of mammary tissue in immature male and female rats. It is not easy then to understand how bilateral testicular atrophy associated with mumps can be followed by gynæcomastia as seen in Figure V. Œstrogen appears to be capable of stimulating interstitial cell neoplasia (Bonser, 1942).

Tumours have been described (Huggins and Moulder, 1945), occurring in man and dogs, which produce œstrogen. Feminizing effects occur. The

tumours are said to arise from Sertoli cells. The testes are often undescended, the dogs become attractive to males and mammary hyperplasia occurs (Greulich and Burford, 1936).

Much work has been done since Zondek's first report on the relationship of testicular tumours to hormone production. The position is becoming clearer and may justifiably be stated as follows. The rare benign embryoma of the testicle is not associated with any abnormal hormone production, nor does this slowly growing congenital tumour cause eunuchoid changes. Seminomata produce no hormone of their own, but cause compression of the surrounding testis with atrophy of interstitial tissue. There is the production by the pituitary of a follicularizing hormone in sufficient quantities to give a reaction to the Aschheim-Zondek test. There is also diminution in androgen production. It is suggested that follicularizing hormone is produced normally, but is then counteracted by the testicular androgen.

Adenocarcinomata and, to a greater extent, chorionepitheliomata themselves elaborate a hormone which is luteinizing in its effect. This is produced in high concentrations, giving a more strongly positive Aschheim-Zondek reaction. At the same time the pituitary gland produces a follicularizing hormone. Ferguson (1933) assumes that the macroscopic appearance of the ovary in this test has a quantitative significance. Thus ripening of the follicle with or without hæmorrhage represented a concentration of 1,000 mouse units per litre. Luteinization and the formation of *corpora atretica* indicated a concentration of 5,000 mouse units per litre of urine. Ferguson (1934) and several others (Twombly, 1944) go on to assume the histological structure of testis tumours from quantitative hormone assays of the urine and to indicate the prognosis, which is said to vary with the concentration of hormone. On the whole this concept is correct, but exceptions are very common. In the cases I examined some surprising results were obtained, although the results of most tests conformed to the current teaching.

Undoubtedly hormonal assays are of importance in the diagnosis and prognosis of testicular tumours. After operation and irradiation the Aschheim-Zondek test should yield a negative response in two weeks. In passing it should be noted that we found the Friedman test quite satisfactory, contrary to some opinions in other countries. The recurrence of gonadotropic hormones in the urine means recurrence of the growth and, in the case of seminomata, the need for further irradiation.

A NOTE ON TESTICULAR TUMOURS.

Interstitial cell tumours and adult embryomata are uncommon. I have encountered no patients with this kind of growth. Other types of tumour are commoner than is often realized. Twenty-five passed through Number 113 (Concord) Military Hospital in a period of three years. Of course the hospital served mostly males in the age period in which such tumours occur, namely, twenty to forty years. I am certain that in this small group diagnosis was made far earlier than in any group recorded, owing to the keenness of medical officers and to their clinical acumen. Probably the communal life brought these men to seek advice earlier than is usually the case. Apart from these cases it is common to find the primary tumour overlooked when the presenting feature is a tumour in the abdomen (Osler, 1907) or some atypical pulmonary lesion.

In our series there were roughly equal numbers of seminomata and teratomata. The outlook is quite different in the two types. In the latter the surgeon plays a minor part. Orchidectomy should be performed, but it is doubtful in many cases whether this influences the result, which depends

not on length of pre-operative history, but on the inherent malignancy of the tumour. They are not radiosensitive. Men with seminomata can be pulled from death's door by prompt treatment. One of our patients was a young man of twenty-six who appeared clinically and radiologically to have severe pneumonia, resistant to all chemotherapy. His condition was low

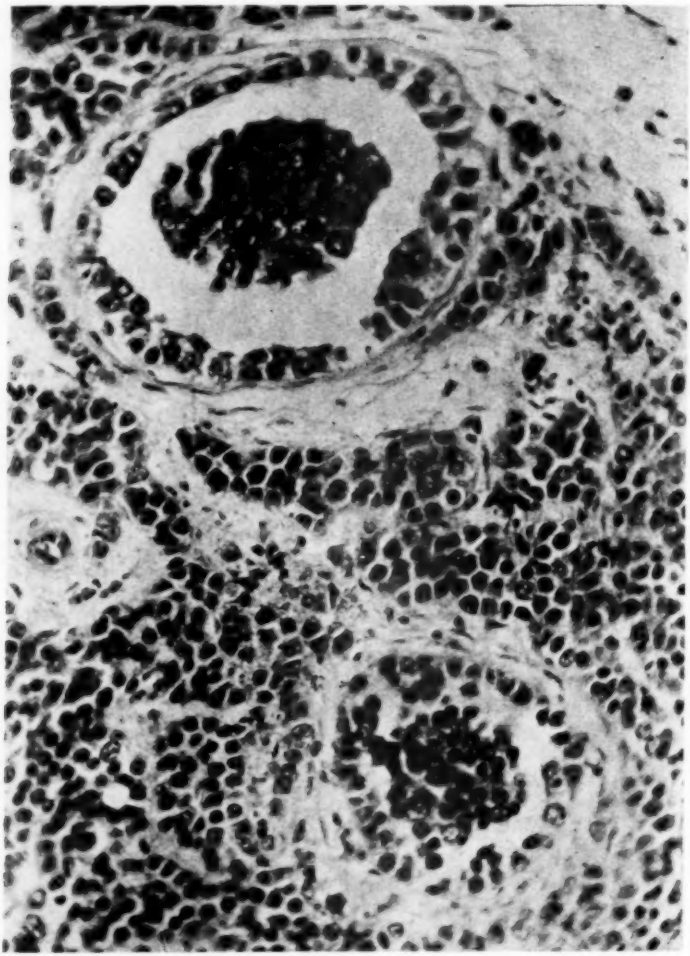

FIGURE VI.

when the physician asked that he be seen by a surgeon as to the possible correlation between his lung condition and a concomitant tumour of the right testicle. The latter was removed under local anæsthesia; it was shown to be a seminoma, despite its clinical appearance of a lobulated swelling, and irradiation of the abdomen and chest was carried out. The patient is alive and well eight months after operation. Only one of fourteen patients with seminoma is known to have died. Five have given reactions to the

Friedman test, but appear to be well. Five of eleven patients with teratoma are dead.

In this country most surgeons consider seminomata as distinct tumours from teratomata. Seminomata occur mostly in a later decade than teratomata; they are radiosensitive, they do not elaborate hormones, and their prognosis is better. Histologically the matter may not be so easy. One

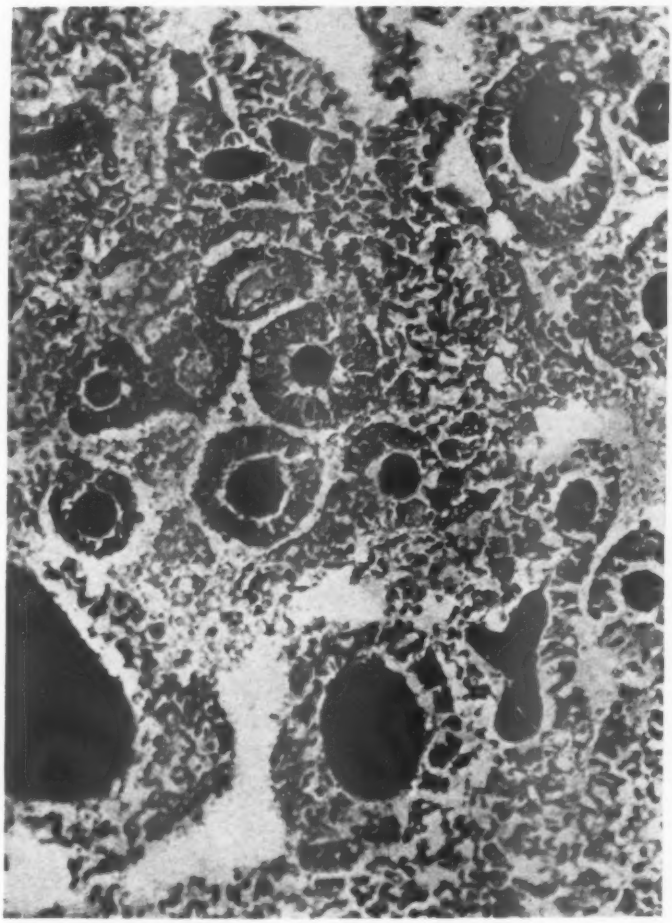

FIGURE VII.

sometimes finds areas of typical seminoma formation in a teratoma. Unicellular tumours may occur especially amongst the malignant adenocarcinomata where the tumour is not obviously a teratoma and yet lacks the uniformity so typical of the usual seminoma. The subsequent history of the case and the careful interpretation of urinary hormone assays should be considered together with the microscopic examination. Following the teaching of Professor Dew (1925), we consider that seminomata are growths of the seminiferous tubules, as suggested in Figure VI. We do not feel

justified in making any statement as to the exact cell from which such tumours arise. Bell (1925) called them spermatocytomata. Bang *et alii* (1935) describe two stages in the development of germinal epithelium at which cells may give rise to identifiable tumours.

Adenocarcinomata may resemble chorionepitheliomata because of their hæmorrhagic appearance. This is frequently misleading, the amount of blood present on section inducing the observer to imagine that he sees trophoblastic tissue. Such a tumour produced a hæmorrhagic secondary in the lung (Figure VII). Here the blood does not bathe the tumour cells, but is surrounded by an endothelium.

SUMMARY.

1. An outline of our present knowledge of testicular descent is given, showing the relationship of the gonad to the caudal end of the intermediate cell mass and its early position near the groin. No explanation of the mechanics of descent is attempted. The description is based on work a summary of which has already been published (1943).

2. Some of the salient features of cryptorchidism are outlined—its comparative anatomy, its resultant structural and functional changes. The predisposition of such testes to malignant change is assessed. The incidence and spontaneous rectification of the abnormality lead to a consideration of the necessity of treatment.

3. Changes in hormone production consequent upon various testicular conditions are discussed. Gonadotropic hormone of the pituitary is necessary for testicular development. Abnormally high amounts of androgen are elaborated by interstitial cell tumours. Seminomata produce no hormone, but teratomata produce a luteinizing hormone. In both the last mentioned the pituitary gland produces an increased amount of follicularizing hormone. The relationship of urinary hormone assays to diagnosis and prognosis is outlined.

4. Some features of testicular tumours are mentioned—the age periods, the ease with which such tumours are overlooked, some distinguishing characteristics of seminomata and teratomata, and the difficulties associated with adenocarcinomata.

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Case Reports.

PROPHYLACTIC HEPARINIZATION IN A CASE OF PYONEPHROSIS COMPLICATED BY RH-NEGATIVE HÆMOLYTIC ANÆMIA.[1]

By H. G. CUMMINE and M. S. S. EARLAM,
From the Department of Urology, Royal Prince Alfred Hospital, Sydney.

THE patient, a female, aged twenty-nine years, was admitted to the Royal Prince Alfred Hospital, Sydney, on November 6, 1945, suffering from a right-sided pyonephrosis. The presenting symptoms had been apparent for one month and were fever, loss of weight, cough, night sweats and a tender mass in the right side of the abdomen.

Past History.

Her past history was of considerable interest. Two Cæsarean sections had been performed for pelvic disproportion. On the first occasion (October 1, 1941) the operation had been carried out at term, when swollen feet and albuminuria (one in eight) were present and the systolic blood pressure was 130 millimetres of mercury. The baby was normal. On the twelfth post-operative day a left femoral vein thrombosis appeared. Three weeks later the right femoral vein became similarly involved. In both instances a classical "white leg" developed. On the patient's discharge from hospital no albuminuria was present, but some degree of anæmia. The hæmoglobin percentage was 73, the colour index 1·04 and the erythrocyte count 3,530,000 per cubic millimetre. On the second occasion (March 29, 1944), Cæsarean section was again carried out at term. A faint cloud of albumin was then present in the urine and the systolic blood pressure was 130 millimetres of mercury. A normal baby was delivered.

A considerable degree of anæmia was present on the day following operation, the erythrocyte count being 2,420,000 per cubic millimetre, and the hæmoglobin percentage 42. On the tenth post-operative day she became febrile and a diagnosis of pelvic thrombophlebitis was made. Oliguria occurred, and finally anuria. This responded to intravenous administration of 500 cubic centimetres of isotonic sodium sulphate solution and 5% dextrose solution on two occasions. The blood urea content rose to 129 milligrammes *per centum*. The blood pressure when urinary secretion was reestablished was 116 millimetres of mercury (systolic) and 70 millimetres (diastolic). The blood urea content fell to 35 milligrammes *per centum*. There was marked pyuria associated with a coagulose-negative *Staphylococcus aureus*.

Anuria again developed in the sixth post-operative week, the blood urea content rising to 102 milligrammes *per centum*. This again responded to intravenous sodium sulphate and dextrose solutions. When urinary secretion was reestablished 860 cubic centimetres of whole blood were given in view of the low hæmoglobin percentage (40). No reaction occurred. One thousand cubic centimetres of blood were given again on the following day with no untoward effects. The hæmoglobin percentage rose to 81. The blood group was O4. There is no record of any sulphonamide administration during the course of the illness.

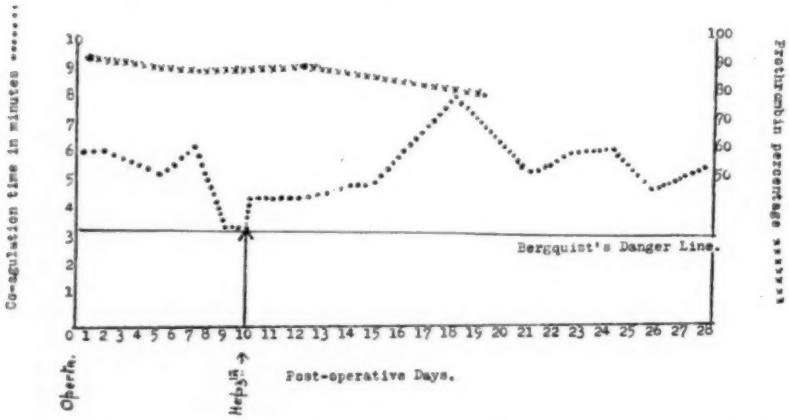
Present Illness.

The patient stated that she had been in good health up till recently. No residual symptoms or signs of the peripheral thrombosis persisted. She looked toxæmic and a large tender mass, apparently kidney, filled the right side of the abdomen from the costal margin to the inguinal ligament. The blood pressure was 110 millimetres of mercury (systolic) and 75 millimetres (diastolic). Culture of the urine contained *Bacillus coli*. Persistent and gross pyuria was present. The blood urea content was 36 milligrammes *per centum* and the urea concentration test revealed considerable impairment of renal function. The best concentration reached was 1·95% in the third hourly specimen. An excretion pyelogram revealed an enlarged right kidney, thought to be functionless, and a moderate degree of left hydronephrosis. This was confirmed

[1] Accepted for publication on August 16, 1946.

by retrograde pyelography, when the right kidney was shown to be hopelessly disorganized. Whilst the patient was in hospital two blood transfusions were given, as the hæmoglobin percentage was 71. The first transfusion consisted of one pint given on November 11, 1945, and the second of one litre given on December 5, 1945. On her discharge there was little appreciable rise in the hæmoglobin percentage. Twenty-seven grammes of sulphamerazine were administered and she improved sufficiently to be discharged after one month's stay in hospital to arrange personal matters prior to the performance of nephrectomy.

The patient was readmitted on February 4, 1946. The swelling on the right side was increasing in size and on several occasions brief attacks of nausea and vomiting had occurred. The blood pressure was 106 millimetres of mercury (systolic) and 70 millimetres (diastolic). During the fortnight before operation there was a continued low grade pyrexia. Pre-operative investigations showed a fall in the hæmoglobin percentage to 59. The erythrocyte count was 4,020,000 per cubic millimetre. A blood transfusion of one pint was given on February 15, 1946, with no untoward reaction. The blood urea content was 45 milligrammes *per centum*. On February 21, 1946, one-stage nephrectomy was carried out through a right lumbar incision. On account



of the size of the kidney, with a lower pole extending to the left of the mid-line, a difficult intracapsular nephrectomy was done to avoid any possibility of damaging the *vena cava*, and in the course of this there was some free bleeding from the pedicle, which was difficult to secure. Blood transfusion was commenced during the operation and continued over the next twelve hours. Three litres in all were given through a cannula tied in the left long saphenous vein at the ankle. The kidney was grossly dilated and disorganized and filled with creamy pus from which *Bacillus coli* was grown. Fifteen grammes of sulphanilamide powder were dusted around the pedicle and in the muscle planes. Within a few hours after completion of the blood transfusions (O4 Red Cross blood), acute hæmolytic jaundice developed. Further investigation showed the donor blood to be Rh positive and the patient Rh negative. In spite of the hæmolysis, the hæmoglobin percentage rose to 68, so no further transfusions of Rh-negative blood were given. No rigor occurred nor was there any pain in the back. The temperature was 101° F. for the first two post-operative days and then varied between 100° F. and normal for the next fortnight after which further convalescence was uneventful. The urea concentration test prior to discharge showed no change. The phenolsulphonephthalein test demonstrated impaired renal function, 23% of the dye being excreted in the first hour and 12·5% in the second hour.

The patient was discharged from hospital on March 21, 1946, with instructions as to diet and vitamin intake; *Mistura Ferri et Ammoniæ Citratis* was prescribed. She reported again on April 23, 1946, and was in good health. Her weight had increased satisfactorily and the blood urea content was 40 milligrammes *per centum* and the uric acid content 2·5 milligrammes *per centum*.

Discussion.

The post-operative care of this patient involved two interesting aspects, the prevention of anuria and prophylactic measures against recurrence of the thrombosis.

Anuria.

In view of the defective renal function and the two previous episodes of anuria following a major surgical procedure, the possibility of a further anuria was considered to be present. When the acute hæmolysis became evident on the day after operation the urine was tested and found to be acid to litmus. There was a considerable degree of hæmoglobinuria. It was decided to alkalinize the urine as rapidly as possible to facilitate the excretion of hæmoglobin products and to minimize any further structural damage to the kidney. Australian Military Forces "D.G.M.S. Technical Instruction" Number 65[1] states: "If the urinary reaction be alkaline at the time of the hæmolysis, the freshly voided urine is bright red in colour and the hæmoglobin passing through the glomeruli shows little if any tendency to be converted into methæmoglobin and acid hæmatin or to form the brown granular precipitate which blocks the renal tubules when hæmoglobinuria is associated with an acid urine." Macroscopically the urine was brownish in colour and contained a granular deposit. This seen under the microscope was composed of amorphous material. A considerable number of leucocytes crammed with this pigment were observed.

An intravenous injection of 400 cubic centimetres of 1/6 molar sodium lactate solution, combined with oral administration of sodium bicarbonate, 24 grammes per twenty-four hours, was carried out. In six hours the urine was alkaline to litmus. The administration of bicarbonate by mouth was continued, 20 grammes per twenty-four hours. On the third post-operative day an acid specimen was passed, so the sodium lactate was repeated. The urine remained alkaline to litmus until the twelfth day, when all signs of hæmoglobinuria had ceased. There was no clinical evidence of alkalosis. No further alkalinization was carried out, as the danger of acid hæmatin crystallization was past. The patient passed 16 ounces of urine on the first and 18 ounces on the second post-operative day. After that diuresis was satisfactory.

The intra-group incompatibility developed in the classical way, in that a series of small sensitizing Rh-positive transfusions had been given and then with the final large transfusion acute hæmolysis occurred. The reaction was not of severe degree and recovery was complete. Inquiry showed that none of the previous transfusions given had been tested for Rh factor, so it can only be presumed that the donor blood was Rh positive.

Prophylaxis against Recurrent Thrombosis.

In view of the previous occurrence of bilateral femoral thromboses on the twelfth and fourteenth post-operative days following the first Cæsarean section and a pelvic "thrombophlebitis" after the second operation, it was thought that this patient should be regarded as predisposed to a further thrombosis. At operation there was considerable bleeding from the renal pedicle, necessitating blood transfusion, and surgical shock occurred. The pedicle was tied *en masse* and was somewhat friable, and the possibility of secondary hæmorrhage was not remote. In view of these facts and the onset of the intra-group blood incompatibility, continuous heparinization was deemed hazardous and it was decided to use daily coagulation times determined by the capillary tube method to detect the "pre-thrombotic" state described by Bergquist.[2] On the ninth post-operative day the coagulation time, which had remained at six minutes before and after operation, fell to three minutes. It remained at this level for fourteen hours, when heparinization was commenced. An intravenous injection of 20,000 units of "Liquæmin" (Roche) in 10 cubic centimetres of sterile water was given. In a few hours the coagulation time was four minutes. Thereafter, through convalescence the coagulation time remained at a level varying between five and eight minutes. It is of interest to note that the diminution in coagulation time occurred about the ninth and tenth days and that her first femoral thrombosis became clinically evident on the twelfth post-operative day. (See accompanying graph.) Bergquist reports the average diminution period as between the fifth and eighth days. He advocates the use of heparin when the coagulation time falls to three minutes and gives an initial dose of 0·6 cubic centimetre of 5% heparin solution. This is repeated (1·0 cubic centimetre) if the coagulation time has not lengthened in four hours and again (2·0 cubic centimetres) in eight hours if required. Bergquist considers that prolongation of the coagulation time to three or four times the patient's normal time is not required. The essential factor is to maintain the time beyond three minutes, which he regards as critical.

In this case no further heparinization was required. The fact of the non-occurrence of thrombosis means nothing, it is admitted, but in view of the known predisposition to thrombosis in this patient and the marked diminution of coagulation times at the time observed by Bergquist, it is submitted that a pre-thrombotic state may have been detected in this patient and that the use of a small amount of heparin at this stage may have averted a further thrombosis.

It is interesting to note that a low-grade infection occurred around the venesection wound at the left ankle. This responded readily to local treatment. Its place as an

ætiological factor in a thrombotic state is undetermined. Prothrombin values were estimated on four occasions. The value pre-operatively was 92% of normal, on the seventh post-operative day it was 85% of normal, and 89% on the twelfth day. On the seventeenth day the value was 76% of normal.

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(1) Australian Military Forces, D.G.M.S. Technical Instruction Number 65, June 29, 1943.

(2) G. Bergquist: "*Über postoperative Thrombosen*", *Acta Chirurgica Scandinavica*, Volume lxxxiii, 1940, page 415; abstracted in THE AUSTRALIAN AND NEW ZEALAND JOURNAL OF SURGERY, Volume xii, 1942-1943, page 155.

AN ABNORMAL BRONCHUS ARISING FROM THE TRACHEA.[1]

By IAN MONK,
Major, Australian Army Medical Corps.

THE steady advance of thoracic surgery and the general acceptance of the dissection technique for removal of lobes and broncho-pulmonary segments of the lung, have increased the interest in lung abnormalities. The following abnormality is therefore considered worthy of recording both because of its practical interest and also because of its comparative rarity.

The abnormality was accidentally discovered during a dissection of a formalinized lung, the specimen having been obtained from a female, aged twenty-two years, who died from a subarachnoid hæmorrhage. There was no contributing cause of death nor was any other disease present.

FIGURE I. Anterior view of specimen.

Description.

The left lung, with all its bronchi and vessels, was normal. The general configuration of the right lung caused little comment except that a rudimentary dorsal lobe fissure was present, the great (oblique) fissure was incompletely developed posteriorly, and the lesser (transverse) fissure was incompletely developed anteriorly.

The abnormal bronchus was found arising from the right postero-lateral aspect of the trachea, 1·5 centimetres above the bifurcation, and running laterally and very slightly downwards to enter the upper lobe. It was approximately 1·0 centimetre in diameter and 1·5 centimetres long (see Figures I and II). The bronchus was distributed to what is normally the apical and subapical broncho-pulmonary segments of the upper lobe (see Figure IV).

The right upper lobe bronchus arose from the right main bronchus in the normal position, but divided into pectoral and axillary branches only. (See Figures III and IV for comparison of normal and abnormal arrangements.)

The right pulmonary artery divided into three main branches, two going to the upper lobe and the third going to the middle and lower lobes; that is, there was an extra ascending branch of the right pulmonary artery which supplied an area of lung corresponding to the apical and subapical segments supplied by the abnormal bronchus (see Figure IV).

The right upper pulmonary veins were normal. Posteriorly, however, there was a separate vein opening into the auricle midway between the superior and inferior pulmonary veins, which drained a portion of the posterior part of the upper lobe and dorsal lobe.

The right middle and lower lobe veins were normal.

[1] Accepted for publication on November 21, 1946.

Discussion.

Not many references were found relative to the above abnormality. Gruenfeld and Gray, in an article written in 1941, describe a "supernumerary apical" or "tracheal" lung, or lobe, as being supplied by a bronchus arising cephalad to the right apical (eparterial) bronchus, above the bifurcation, that is, originating from the trachea. They state that only two such abnormalities have been described in the literature. It is not clear, however, whether they themselves are reporting such an abnormality; also they do not state whether the "tracheal lobe" referred to is separated by a fissure, is extra to the upper lobe, or supplants some of the upper lobe segments.

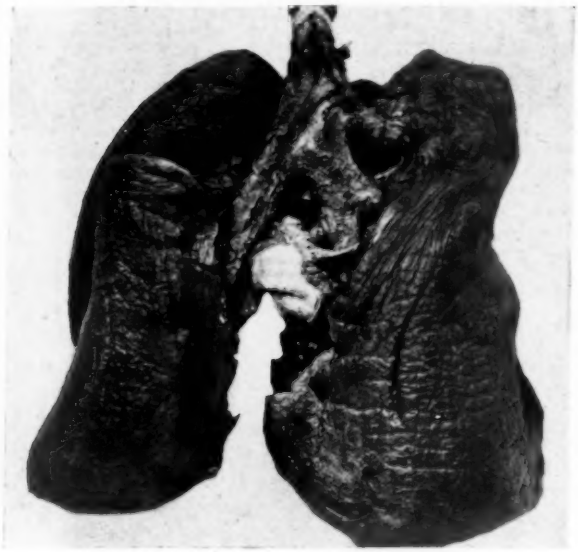

FIGURE II. Posterior view of specimen.

However, Kaufmann makes the following statement: "An extra branch to the upper lobe may come off above the eparterial bronchus from the R. main bronchus, junction of trachea and bronchus, or even the trachea."

A second right upper lobe bronchus is frequent in cetaceans and other mammals, and occasionally in man a double right upper lobe bronchus is found. Tracheal diverticula are said to be less uncommon.

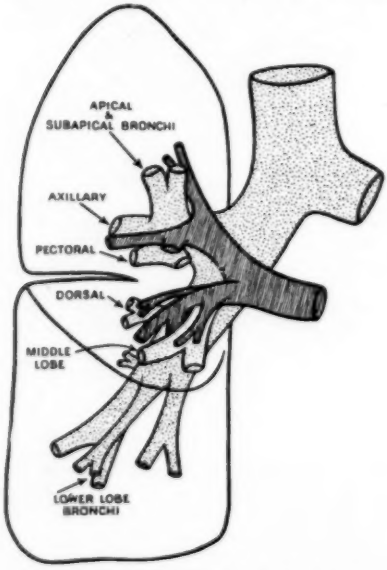

FIGURE III. Relation of right pulmonary arteries and bronchi.

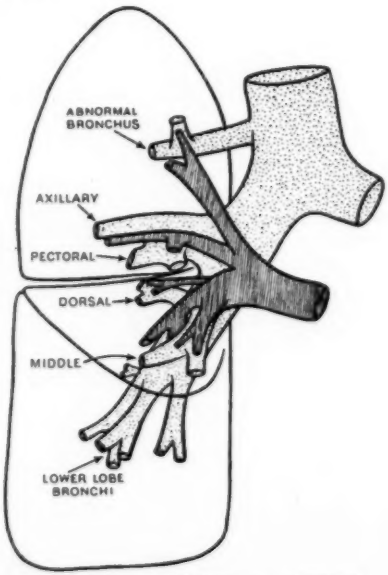

FIGURE IV. Relation of abnormal bronchus and artery shown.

An interesting case is referred to as being reported by von Haberer. A cyst was removed surgically from the upper right interlobar fissure, a pre-operative X-ray examination having shown a bronchus apparently originating above the bifurcation of the trachea and running towards the site of the cyst. Unfortunately no further details were obtained.

Summary.

1. An abnormal bronchus, arising from the right side of the trachea and running to the right upper lobe of the left lung, is described. A pulmonary vein running from the posterior aspect of the upper lobe of the lung to the auricle is also described.

2. A review is made of some of the relevant literature.

Acknowledgements.

I would like to thank Lieutenant-Colonel E. S. J. King for advice and help in preparing this article, and Major John I. Hayward for his helpful criticism. My thanks are also due to Sergeant Hanson (Women's Australian Auxiliary Air Force), of the Number 2 Facio-Maxillary and Plastic Surgery Unit, for the photographs.

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E. Kaufmann: "Pathology for Students and Practitioners", translated by S. P. Reimann.

Surgery in Other Countries.

[In this column will be published short résumés of articles likely to be of practical value from Journals published in other countries and not readily accessible to surgeons in Australia and New Zealand.]

THE CLOTTED HÆMOTHORAX.

E. Curtillet, Grasset and J. Houel: "*L'hémothorax cloisonné à dépôt fibrineux hémothorax imponctionnable*", *Journal de chirurgie*, Volume lxii, 1946, page 5.

ALTHOUGH the so-called "clotted hæmothorax" was described by Lonermant in 1911, it is only in the recent war years that the condition has come into prominence. Various authors estimate its frequency at from 10% to 16% of all hæmothoraces seen.

In the early stages the clinical signs are those of any large fluid collection, and the blood can be withdrawn by aspiration, but later, after eight to ten days, the picture alters. Clinically and radiologically the signs remain the same, but aspiration will produce only a few cubic centimetres of fluid. This may disconcert the clinician, who may doubt the existence of a pleural collection and ascribe the condition to a massive pulmonary congestion. This is a probable explanation of many reported cases of massive pulmonary congestion following chest wounds. Such a condition, without sputum or signs directly referable to the lungs, and afebrile, probably does not exist.

If the thorax is opened the condition revealed is characteristic. The pleural cavity is filled with fibrinous strands like a spider's web, running in every direction, crossing and recrossing, dividing the space into multiple loculi, each filled with blood. In the first four weeks these strands are soft and can easily be gathered up and removed by the fingers. At the walls of the cavity they are attached to large sheets or pseudomembranes, which are at first fibrinous, later fibrous. When all this fibrinous deposit has been removed, the full extent of the cavity becomes evident. The appearance of the surface of the collapsed lung differs according to the time at which the exploration is made. In the early stages it is reddened and shining, but quite supple, and the lung can easily be expanded by positive pressure. Seen after some twenty days, it is dark red, like the surface of an old hæmatoma. The angles of the cavity are rounded. The lung surface is rigid and hard to the finger, and the lung will no longer expand under positive pressure. The fibrinous coating is about 2·0 to 3·0 millimetres in thickness and can be readily stripped off, an approximately normal lung surface being left.

The pathological basis of the condition is not quite clear. It differs entirely from ordinary coagulation, which, when it occurs, is always immediate and produces large clots. The new formation in the condition under discussion is due to a slowly progressive formation of fibrinogen, but why this should occur in these particular cases is yet unknown. It is not simply due to the passage of time; and the authors do not accept the explanation put forward by Price Thomas and Barrett that it is due to a "humoral" action produced by the passage of the projectile through the tissues. They believe that the probable cause is an attenuated form of infection. In seventeen cases of clotted hæmothorax Curtillet, Grasset and Houel have been able to demonstrate the presence of bacteria in five, and in three there were no clinical signs of infection whatever. They support their argument by comparing the increased incidence of clotted hæmothorax in the recent war with the increase in attenuation in other forms of infection. They have themselves noted a considerable number (about 9%) of serous or sero-sanguineous pleural effusions which were sterile on culture, but contained many polymorphonuclear leucocytes in altered forms, and which progressed easily to cure after a few aspirations. When one thinks too of the numerous cases of bacterial pleurisy which heal in a few days with drainage, and the cases of afebrile pleurisy which will heal even without drainage, one must accept the fact that pleural infection has taken on a new form since the general adoption of sulphonamide and penicillin therapy. It is in the same circumstances that the clotted hæmothorax has become more prominent. Holmes Sellors is inclined to attribute the increase in clotted hæmothorax cases to the irritant effect of penicillin given intrapleurally. This suggestion, however, disregards the fact that a clotted hæmothorax appears frequently in cases in which penicillin or sulphonamides have been given entirely by routes other than the intrapleural. The effects of these drugs in leading to an increase in clotted hæmothorax come from their power of attenuating what would otherwise be an active infection.

The collections described can be reabsorbed without any treatment, but in fact they very seldom are. The effusion may remain unchanged for some months, after which a retractile fibrous organization takes place and after a period of months or years this produces a very serious physical and functional end result. The chest is retracted, the lung is opaque radiologically, scoliosis develops and the chest expansion is reduced to nil. This condition was frequently seen in patients who suffered chest wounds in the 1914-1918 war, and this indicates clearly that a hæmothorax should never be left untreated, quite apart from the fact that in many of them a frank infection will develop. The old classical view that a hæmothorax should be left alone for ten days and then carefully aspirated is now given up. The old fear of secondary hæmorrhage has been shown to be unfounded, and early aspiration is the rule. The third day is the time of election, and the authors prefer to evacuate effusions of up to 1,500 cubic centimetres completely in one stage. If the effusion is more copious than this they would draw off smaller amounts in several aspirations. If this early emptying is not carried out, one is likely to be confronted with a clotted hæmothorax and then open operation is the only reasonable procedure.

If the operation is performed within the first ten days the contents of the pleural cavity are removed manually and the walls cleaned of all fibrinous exudate. The lung is distended by positive pressure and the wound closed with suction drainage. When the operation takes place later, say in the third week after the wounding, a more formal "decortication" of the lung may be necessary. The fibrinous coat is 2·0 to 3·0 millimetres thick, but on incision of this a well-marked plane of cleavage is found and the whole exudate layer can be peeled off with very little bleeding. This must be thoroughly and completely done, special attention being paid to the angles of the cavity, and after it has been completed the lung can be inflated and the operation terminated as in the earlier cases. This operation is not difficult and in itself it holds no special dangers. Price Thomas has published twenty cases in which no untoward incident occurred. The present authors, however, have seen two patients succumb, one in forty-eight, the other in seventy-two hours, both being proved at autopsy to have suffered from thrombosis of the pulmonary artery after an operation entirely normal in its performance. A third out of their series of seventeen patients died on the twenty-second day from septic complications. None of these patients would probably have died if decortication had not been performed and, after all, the authors observe, decortication is not a life-saving procedure. The development of penicillin therapy may bring a very much greater protection to patients than now exists, but nevertheless Curtillet and his colleagues are of the opinion that decortication and its risks ought to be avoided if it is reasonably possible to do so. And they have achieved a very satisfactory result with one such patient in whom, although the lung appeared to be restricted in a firm fibrinous coat, the chest wall was closed and a negative pressure of 10·0 to 20·0 centimetres of mercury was applied. This patient was operated upon on the fifteenth day, and on the day following operation the lung had expanded to reach the thoracic wall. Patients operated on still later should be amenable to the same treatment, and the history of a patient so dealt with by Santy in the fourth month of his wound is of great interest.

Present conclusions may be premature, but in the opinion of the authors the indications at the moment are: (i) Operate as early as possible. Such an operation is simple and brings swift and complete cure. (ii) If owing to infected wounds or other reasons the operation has been left till too late for the simple procedure, clean out the cavity and decide on the merits of the case whether decortication should be carried out or treatment by strong negative pressure drainage instituted. Decortication is a most valuable resource, but it carries a certain risk and should give place to the simpler method whenever possible.

ARTHUR E. BROWN.

THE LATE RESULTS OF SPLANCHNICECTOMY.

R. Fontaine, E. Forster and Cl. Stafanini: "*Résultats éloignés de 63 splanchnicectomies pour diverses affections (en dehors de l'hypertension artérielle chronique permanente)*", *Lyon chirurgical*, Volume xli, 1946, page 279.

FONTAINE, FORSTER AND STAFANINI present a report of their work on splanchnic resection between 1940 and 1945. Altogether they performed 160 resections of the splanchnic nerves on 112 patients; but, as they are preparing a separate report on the results of the operation when performed on account of chronic persistent arterial hypertension, they exclude this group and discuss here only the value of this operative method for such conditions as *thrombo-arteritis obliterans*, Raynaud's disease, mega-œsophagus, megacolon *et cetera*. The mortality attributable to the 99 operations reported is one death, an indication of its limited risk in safe hands.

Fourteen patients were suffering from obliterative arteritis and 23 operations were performed on them. This disease is considered as consisting of four stages or degrees. In the first there are no symptoms, the collateral circulation maintaining an efficient blood supply. In the second stage intermittent claudication indicates a developing inefficiency of the circulation, and it passes on to the third stage, in which ischæmia is evident even at rest, and the fourth, in which ulceration and gangrene occur.

Seven patients were operated on in the second stage, three in the third, and in four of them the fourth stage had been reached in one or other limb. Results were classed as excellent if the patient was restored to the condition obtaining ordinarily in the first stage. Of these there were five, while seven patients were greatly improved and two only temporarily improved. The results of splanchnicectomy together with upper lumbar sympathectomy are definitely good in obliterative endarteritis, even in the advanced stages. In the most favourable cases the disease appears to be actually arrested by splanchnicectomy, while the sympathectomy improves the collateral circulation, but this arrest is in most patients only temporary. Even a bilateral splanchnicectomy cannot apparently be relied upon to arrest the progress of the disease with any certainty. Its beneficent effect seems to be brought about owing to the denervation of the suprarenal and the consequent diminution of adrenal output, but whether it is actually the logically correct and best treatment for arteritis is not certain. So far, the cause of this disease is unknown, and one is reduced to hypotheses. The truly correct treatment may still be undiscovered, but in the meantime resection of the splanchnics is a very great help.

Adrenalectomy is not its equal. It has scored some brilliant successes, but has also a record of recurrences and failures. The endocrine theory of the origin of *endarteritis obliterans* is at present the most attractive, and it would seem natural to attack the suprarenals directly. But their secretion is not the only vaso-constrictor substance in the circulation, and in any case a unilateral resection would be insufficient for cure. Bilateral splanchnicectomy is only a partial suppressant of adrenal secretion. In the present state of our knowledge a bilateral splanchnicectomy combined with the removal of one suprarenal gland offers the best method of therapy known. It is admittedly not perfect. Lumbar sympathectomy makes no pretence of attacking the cause of the condition, but it does give local relief to the circulation of the limb.

Raynaud's disease, being a purely vaso-constrictive phenomenon, should in theory be ideally suitable for treatment by sympathectomy, but it is not. Repeated failures among brilliant results indicate that sympathectomy as at present practised is not the solution of the problem of this condition. This is not due, as has been suggested, to any question of cutting pre-ganglionic or post-ganglionic fibres, but to the fact that the sympathetic section is performed actually too far from the point at which the vaso-constrictor impulses act. Raynaud's disease is not a disease of the sympathetic chain or its branches. Its crises are originated by the same stimuli which normally produce vaso-constriction, and by the same methods. Where Raynaud's disease differs from the normal state is only in the intensity of the response. This presupposes a hyperexcitable peripheral vasomotor mechanism, together with occasionally occurring suitable stimuli. Adrenalectomy has not so far proved effective in the hands of Leriche.

The authors present three cases. In the first bilateral resection of the stellate ganglion failed as completely as had splanchnicectomy combined with adrenalectomy. In the second bilateral splanchnicectomy combined with adrenalectomy achieved a great improvement without any other treatment. In the third a double stellectomy failed to give any relief, but this was at once achieved after resection of both splanchnics and the left suprarenal gland. In two of these patients good results could be claimed, but none was completely cured, and the authors' conclusion is that at present any certain cure of Raynaud's disease is beyond our power and will remain so until the exact cause of the arteriolar hyperexcitability and the true origin of the crises are better understood.

Turning to the question of mega-œsophagus, the authors discuss two patients, both women, whom they treated in 1941 and who both suffered from this condition in a severe degree. Both splanchnics were infiltrated by the method of Leriche and the œsophagus was immediately seen, under X-ray observation, to empty itself easily by successive ejaculations. Repeated infiltrations produced such great functional improvement in both of these patients that although anatomically no alteration in the condition could be noted, they both rejected the idea of further treatment.

This experience encouraged the authors to resect the splanchnics of two other patients to whom infiltration had failed to give more than temporary relief. Both operations failed completely to achieve any permanent cure. That the splanchnic nerves do exercise a decided degree of control over the movements of the œsophagus is demonstrated by the cases cited, but this effect does not appear to be either as complete or as instantaneous as that produced by the inhalation of amyl nitrite, which

acts on the peripheral nerve endings themselves. After infiltration the effect of the substance infiltrated spreads from the ganglia towards the periphery, and this gives better results than does the more central attack of surgery on the splanchnics and the ganglia. The success of Heller's operation is probably due to the fact that its action point is as far peripherally as surgery can go, all local fibres that can be found being severed instead of two distant trunks. Heller's operation should in fact be regarded as a neuro-surgical operation rather than as a mechanical attempt to widen the œsophageal outlet. In three out of six operations of the Heller type the present authors contented themselves with cutting all visible nerve fibres and made no attempt to carry out muscular incisions. The results in these three cases were quite as good as those obtained by the more orthodox "Heller" operation. Functional improvement is sure and lasting, even though the anatomical appearances remain unaltered. But recurrence even after eight to ten years is still always possible.

In fact, mega-œsophagus cannot be cured at the present time, but the closer the sympathetic section can be brought to the actual œsophageal nerve endings, the more hopeful apparently are the results.

The authors performed twenty-two operations on sixteen patients suffering from megacolon. All the patients were women, and the results in eleven of them, satisfactorily followed up, have been encouraging. In all cases the operation chosen was section of the splanchnic, or splanchnics, combined with resection of the first and second lumbar ganglia. Mallet-Guy's plan of selecting the segment of sympathetic for removal according to the segment of the colon most affected has not been followed. Six of the patients got an excellent result, the condition of two was greatly improved, while three of the operations were written down as failures. This line of treatment offers great hope in such cases.

Twelve patients were subjected to operation on account of painful hydronephroses. In eight of them splanchnicectomy was performed along with resection of the first and second lumbar ganglia. Four patients had the aortico-renal ganglion removed only, while one had the latter operation on one side and splanchnicectomy on the other. Of the eight submitted to splanchnicectomy, three had excellent results, three showed great improvement, one was moderately improved, and one failed to obtain relief. Of the other five operations, one was excellent in its results, two patients were greatly improved, and one was moderately improved. The other had an excellent result, but as the lower polar artery was cut at the time of the operation and the results might therefore be considered as vitiated, it has been rejected.

When these results are compared with those obtained by simple removal of the aortico-renal ganglion, they are found to be almost identical. The addition of the procedure of nephropexy, which is sometimes advocated, would appear to be quite unnecessary. The authors profess themselves unable to choose between the two procedures, by either of which good results will be obtained.

ARTHUR E. BROWN.

Reviews.

Penicillin: Its Practical Application. Edited by SIR ALEXANDER FLEMING, F.R.C.P., F.R.C.S., F.R.S.; 1946. London: Butterworth and Company. 8½″ × 5½″, pp. 380, with 59 figures. Price: 38s. 9d.

PENICILLIN has been in use for some two years and it is fitting that a book, in which is gathered all the facts, should be published at this time. It is fitting, also, that such a book should be edited by Sir Alexander Fleming.

With the knowledge that there must be some overlap and some difference of opinion, the editor has gathered together twenty-nine authors, each prominent in his own specialty, to contribute articles on different aspects of penicillin. The general section, comprising six chapters, deals with the history, chemistry, manufacture, pharmacy, bacteriological control and methods of administration of penicillin. The romance of the discovery and development of the drug is described in this section, which is of absorbing interest and should be studied by all who use penicillin.

The clinical section comprises twenty-one chapters in which are discussed the uses of penicillin in the infections of medicine, surgery and obstetrics, together with their associated specialties, as well as chapters on dental infections and diseases of animals. No disease in which penicillin is effective appears to have been omitted. This section must be regarded as made up of chapters for reference rather than for continuous reading, as it is unlikely that surgeons, for instance, would be interested in the study of the application of penicillin to skin diseases or a physician in the study of gas gangrene. A generous bibliography is given at the conclusion of each chapter.

One small omission which was noted is that the amount of solvent for intramuscular injections is not recommended. It is known that the more concentrated the solution used, the higher will be the level of penicillin attained in the blood stream and the more prolonged will be its presence. For example, 100,000 units administered in ten cubic centimetres produce two units per cubic centimetre in the blood and remain in detectable amounts for six hours; whereas the same dose in one cubic centimetre of solution produces four units per cubic centimetre and remains for seven and a half hours.

Confrontations radio-anatomo-cliniques. By DE M. CHIRAY, R. A. GUTMANN and A. J. SENEQUE. Paris: Masson *et Cie*. 12¾" × 10", pp. 56, with 96 figures.

"CONFRONTATIONS RADIO-ANATOMO-CLINIQUES" is the first volume of a radiological atlas which is being produced by the well-known French medical publishing company G. Doin *et Cie*, Masson *et Cie*. It is intended that this atlas will contain not only classical X-ray pictures of the various systems of the body, but also those which are atypical and which therefore may lead the specialist or practitioner to make an erroneous diagnosis; it is reflex of the hazards of the X-ray clinic.

The first volume contains mostly very well produced gastro-enterological radiographs on beautiful art paper. The clinical history of each case is given and in most instances also a detailed description of the operation, a picture of the operation specimen, and a photomicrograph.

The publication is of special interest to the X-ray specialist, but it will enrich the knowledge of the surgeon who is often called upon to make a final judgement in a case in which the question of diagnosis and operation hinges on his opinion formed on data of which the X-ray criteria form only part.

Le Syndrome de Volkmann. By MAURICE CAHUZAC and FRANÇOIS JUNG; 1946. Paris: Masson *et Cie*. 7½" × 5¼", pp. 98.

"LE SYNDROME DE VOLKMANN" is the title of a small volume which is a pathological and therapeutic study of Volkmann's disease. It is written by Cahuzac and Jung and has a preface by Professor Leriche. The authors put forward their views of the cause and treatment of the Volkmann's syndrome, which they base on a study of a series of cases. An arterial trauma, a contusion or rupture, or a simple spasm originates the disorder. A consecutive ischæmia is responsible for nervous troubles and muscular necrosis. Concomitant vasomotor disturbances are caused by a vasoconstrictor reflex which starts in the traumatized arterial wall and ends in an infarction which eventually results in the late cicatricial syndrome characteristic of Volkmann's disease. Treatment is designed to counteract the originating condition. When there are signs of vasomotor disturbance in a serious injury of the upper limb, arteriectomy or sympathectomy and repeated anæsthetic infiltrations of the stellate ganglion should be instituted. The fracture is carefully reduced under the screen. When the condition is well established, measures directed to the sympathetic supply help to improve the condition and relieve the trophic disturbance.

In this work those interested in the condition will find a monograph based on some original observations and work.

Anæsthetic Methods. By GEOFFREY KAYE, M.D., D.A. (R.C.P. and S. Eng.), in collaboration with R. H. ORTON and D. G. RENTON; 1946. Melbourne: W. Ramsay (Surgical) Proprietary, Limited. 9" × 5½", pp. 76, with 188 figures. Price: 50s.

THE author and his collaborators in this work have done much in Melbourne for education in anæsthesia and the book is a worthy product of their pens. There have been many recent contributions to the literature on anæsthesia and this book can take its place among the best of them. The 656 pages of the volume contain a wealth of information lucidly presented and covering a wider field than most books on the subject. Local and regional anæsthesia has been omitted, probably because this form of anæsthesia has remained the province of the surgeon rather than the anæsthetist in this country.

The author indicates in his preface that the book is intended to cater for the recent graduate, and as it is at this stage of their careers that medical officers are called on to administer their first anæsthetics without supervision, it will serve as an admirable guide and may with profit be made available to residents in all institutions.

Bearing in mind the purpose for which the book is written it is as well that attention is drawn to: (i) the risks in the use of (*a*) carbon dioxide, (*b*) insufflation technique in endotracheal anæsthesia, (*c*) intravenous anæsthetics, (*d*) combinations

of anæsthetic agents; (ii) the advisability of oxygen administration during all forms of anæsthesia.

The early chapters are devoted to a sound introduction, discussion on respiration, care of the patient, assessment of anæsthetic risk, choice of anæsthetic and premedication. Then follows an account of the volatile anæsthetics clearly presented with ether in its usual priority. Endotracheal anæsthesia is well done, the use of the inhalation technique being stressed rather than insufflation methods with their obvious risks and disadvantages.

The four subsequent chapters are devoted to gas anæsthesia and carbon dioxide absorption. In this age of mechanization of anæsthesia it is of paramount importance for the anæsthetist to have a sound knowledge of the construction of the equipment he uses. Not only in these chapters, but throughout the book, the sectional diagrams and illustrations of equipment are excellent and should be of great assistance to the operator both in the detection of faults during anæstnesia and in the maintenance of equipment generally.

Nitrous oxide and ethylene are dealt with fully, but in view of the present trend in gas anæsthesia fuller discussion on cyclopropane would be welcome. The chapter on intravenous anæsthesia is presented conservatively, and not without reason, as the recent graduate is attracted by its ease of administration without being entirely cognizant of the risks involved. Spinal anæsthesia is very well presented, particularly as to the anatomy and technique of lumbar puncture and the regional posturing of the patient.

The final chapters include much useful information on oxygen therapy, blood transfusion, fires and explosions, death under anæsthesia, records, and the anæsthetist and the Australian law.

In the appendices curare is briefly discussed and it is a pity the book has emerged prior to the advent of the recent commercial preparations of curare derivatives.

The author and his collaborators have obviously devoted much time and care in compiling this volume, which can be of infinite value not only to the recent graduate but to the practising anæsthetist as well; it must be regarded as one of the most valuable contributions of its kind.

A Short Handbook of Practical Anæsthetics. By H. PARRY-PRICE, M.R.C.S., L.R.C.P., D.A. (R.C.S.); 1946. Bristol: J. Wright and Sons. 7½″ × 4½″, pp. 127, with 50 figures. Price: 12s. 6d. net.

As the author states in his preface, this is not a textbook but rather an account of practical experience in the eventful twenty-five year period of anæsthesia from 1920 to 1945, including service experience in the recent war. It is a small book of 125 pages, commencing with a useful introduction mainly concerning the comfort of the patient during induction. Chapter II concerns instructions on anæsthetics for the nursing staff, and these are more comprehensive than most students receive in this country. In subsequent chapters all forms of anæsthesia are very briefly discussed, including the use of controlled respiration, which is inadequately described. In general, preoperative sedation is heavier and a mixture of anæsthetic agents is more commonly used by the author than in this country. There is much common sense, with some "useful dodges" and anecdotes, in this little book, which is not intended as a profound study.

The Traumatic Deformities and Disabilities of the Upper Extremity. By ARTHUR STEINDLER, M.D., F.A.C.S., and J. L. MARXER, M.D.; 1946. Springfield, Illinois: C. C. Thomas. 10¼″ × 6¾″, pp. 494, with 443 figures. Price: $10.00.

THERE is little to criticize in this volume by Arthur Steindler. Steindler has made many notable contributions to our knowledge of orthopædic and traumatic surgery, and his clinic at the Iowa State University ranks with the best in the United States of America. From such a source—for, as hinted in the foreword, many of the views expressed are those of the clinic rather than the personal opinion of the author—one expects to find the answers to most of the problems connected with injuries of the upper extremity. Few readers will be disappointed.

The book is divided into two parts. Part I, consisting of 61 pages, is really the introduction, and deals with general principles. In it much useful information concerning the correction of deformities, the use of splints and appliances, and the restoration of function after injury will be found. Part II deals in detail with every form of injury to the upper extremities. Beginning with the clavicle and shoulder region, the author works steadily down the arm for 400 odd pages, ending with a note on cineplastic operations and their requisite prostheses.

At times the work suffers from a superabundance of material, and Steindler is frank enough in the foreword to admit to occasions when "we could not always

suppress a feeling of uncertainty familiar to any teacher". This refreshing honesty is to the authors' credit and contrasts strangely with the assertiveness of the majority of orthopædic authors. It has the advantage also that, even if a definite expression of opinion is not forthcoming, methods are described and statistics and case histories quoted so that the critical reader is in some position to draw his own conclusions.

In a work of such uniform excellence it is difficult to pick out one section either for praise or criticism. Much depends on the individual reader. We found, for instance, much that was orthodox and in consequence called for no comment, whereas the real highlights were the sections on the simple injuries, the ligamentous strains and sprains at the shoulder, elbow and wrist, which are sustained so easily and yet at times defy all the usual forms of therapy. It is here that the accumulated experience of thousands of cases is added to the wisdom of years and finds fullest expression. In this category also can be rated the sections on injuries and disabilities of the hand, in which the fullest acknowledgement is made to the classic work of Bunnell.

Internal fixation of unstable fractures and of bone grafts has apparently been practised for years as a routine procedure. It is interesting to find so many different dislocations and subluxations for which fascial sling operations are advocated, for many of these have proved singularly unsuccessful in other hands. Not all will agree with the authors when they write of Volkmann's ischæmia: "we no longer accept . . . that the cause of the contracture is an arterial ischæmia . . . it is an impediment of the venous backflow which is responsible for the degenerative changes in the muscle".

The text is interspersed with 1,048 illustrations. The drawings and photographs are above criticism, but many of the reproductions of skiagrams lack clarity and are not up to the standard of the others. One notable feature is the proximity of the illustrations to the relevant text, a feature which adds greatly to the reader's pleasure. Two hundred and sixty case histories are quoted in some detail. While they have been selected to illustrate the particular method of treatment used, in many instances they add little or nothing to what has already been revealed in the text. In particular those in which the follow-up has been quite inadequate could well be omitted from subsequent editions. British readers will have to accustom themselves to such expressions as "inveterate" and "habitual" (dislocations), anatomic and pathologic, and motion (movement) *et cetera.*

The fullest acknowledgement to other authors is made in a complete bibliography at the end of each chapter. A pleasing feature is an authors' index at the end of the book. This is altogether a stimulating contribution well up to the high standard already set by the author.

A Synopsis of Orthopædic Surgery. By DAVID LE VAY, M.S., F.R.C.S.; 1947. London: H. K. Lewis and Company, Limited. 8¾" × 6", pp. 250, with 55 illustrations. Price: 15s.

THE title of this excellent book may lead one to speculate how orthopædic surgery can be surveyed in a little more than 200 pages. This has been accomplished by the exclusion of any discussion of fractures and the author has succeeded in producing an attractive book.

Systemic skeletal disorders are first discussed and then follow chapters on local diseases of bone. The last two thirds of the book are concerned with regional orthopædic disorders and contain excellent descriptions of various syndromes, such as cervical rib, low back pain and sciatica, internal derangement of the knee. Minor abnormalities, such as bunion, painful heel and ingrowing toe-nail, all receive the attention due to them.

Considering the wide scope of the author's subject, he is to be congratulated on presenting it in an attractive manner which makes enjoyable reading. There is no suggestion, as there is in some synopses, that the matter has been catalogued.

The book contains no photographs or X-ray illustrations, points being made clear by diagrammatic illustrations. We confidently recommend this book to all those who wish to have a clearcut survey fo orthopædics, especially to post-graduates reading for higher degrees.

Illustrations of Anatomy for Nurses. By E. B. JAMIESON, M.D.; Second Edition; 1946. Edinburgh: E. and S. Livingstone. 8¼" × 6¼", pp. 76, with 64 plates. Price: 8s. 6d.

THIS book has already proved of the utmost assistance to teachers of nurses and to nurses themselves, who have practically no opportunity of seeing the dissected parts.

The author's "Illustrations of Regional Anatomy" have found great favour in recent years with medical students and post-graduates. In this volume sixty-four of these illustrations have been selected as being suitable for nurses undergoing instruction in anatomy. The drawings have been taken from actual dissections, but have a diagrammatic element which enables ready interpretation. The alterations and additions in this second edition are to be highly commended.